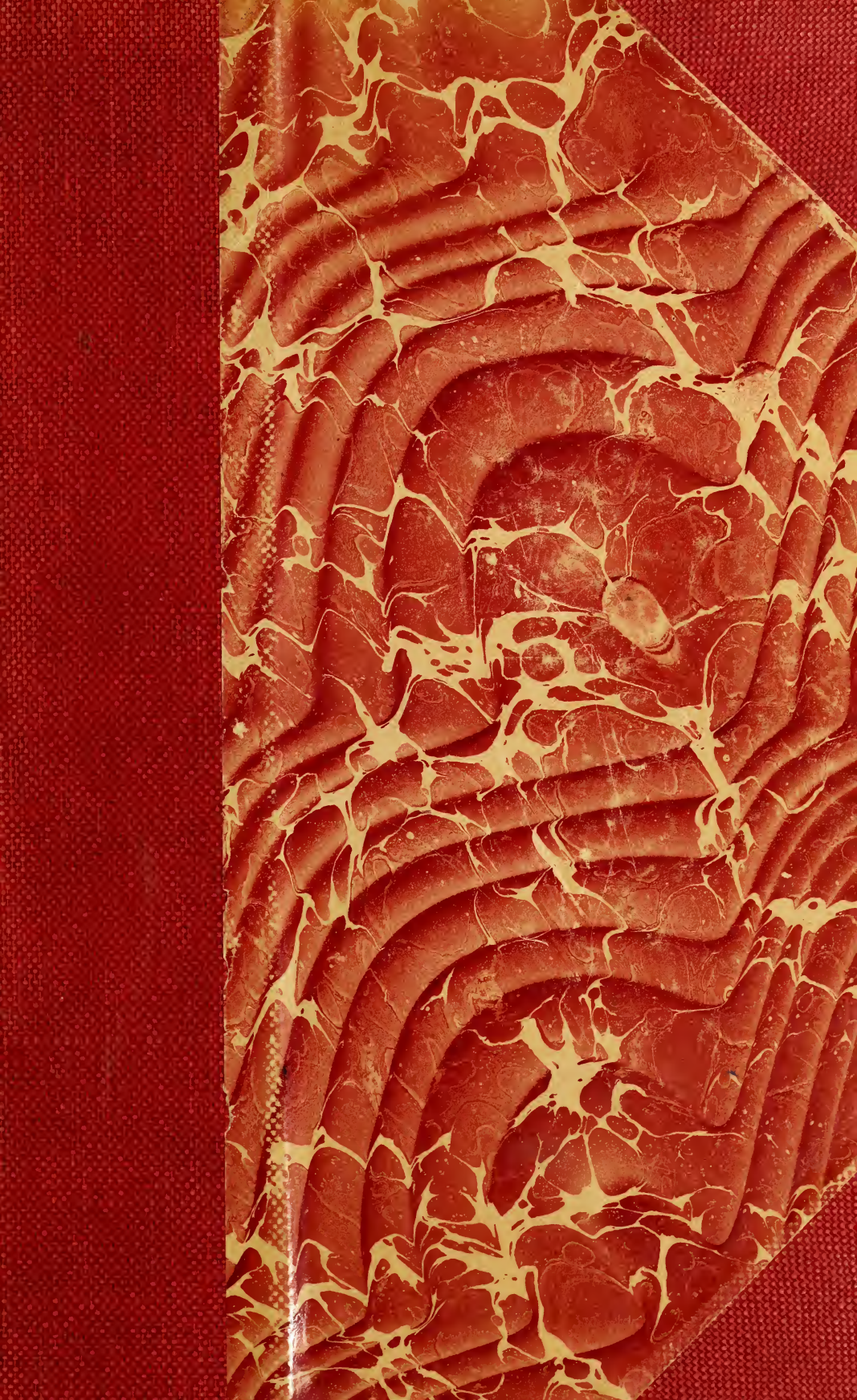




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September 19, 1912 - March 30, 1915

BULLETIN
OF THE
Wisconsin Natural History
Society

VOLUME XI
(NEW SERIES)



PUBLISHED WITH THE COÖPERATION
OF THE

Public Museum of the City of Milwaukee

EDITOR:
RICHARD A. MUTTKOWSKI

ASSOCIATE EDITORS:
HOWLAND RUSSEL

P. H. DERNEHL

EDGAR E. TELLER

WAVERLY PRESS
BALTIMORE, MD.

The Wisconsin Natural History Society

MILWAUKEE, WISCONSIN

ORGANIZED MAY 6, 1857

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(MAY, 1914)

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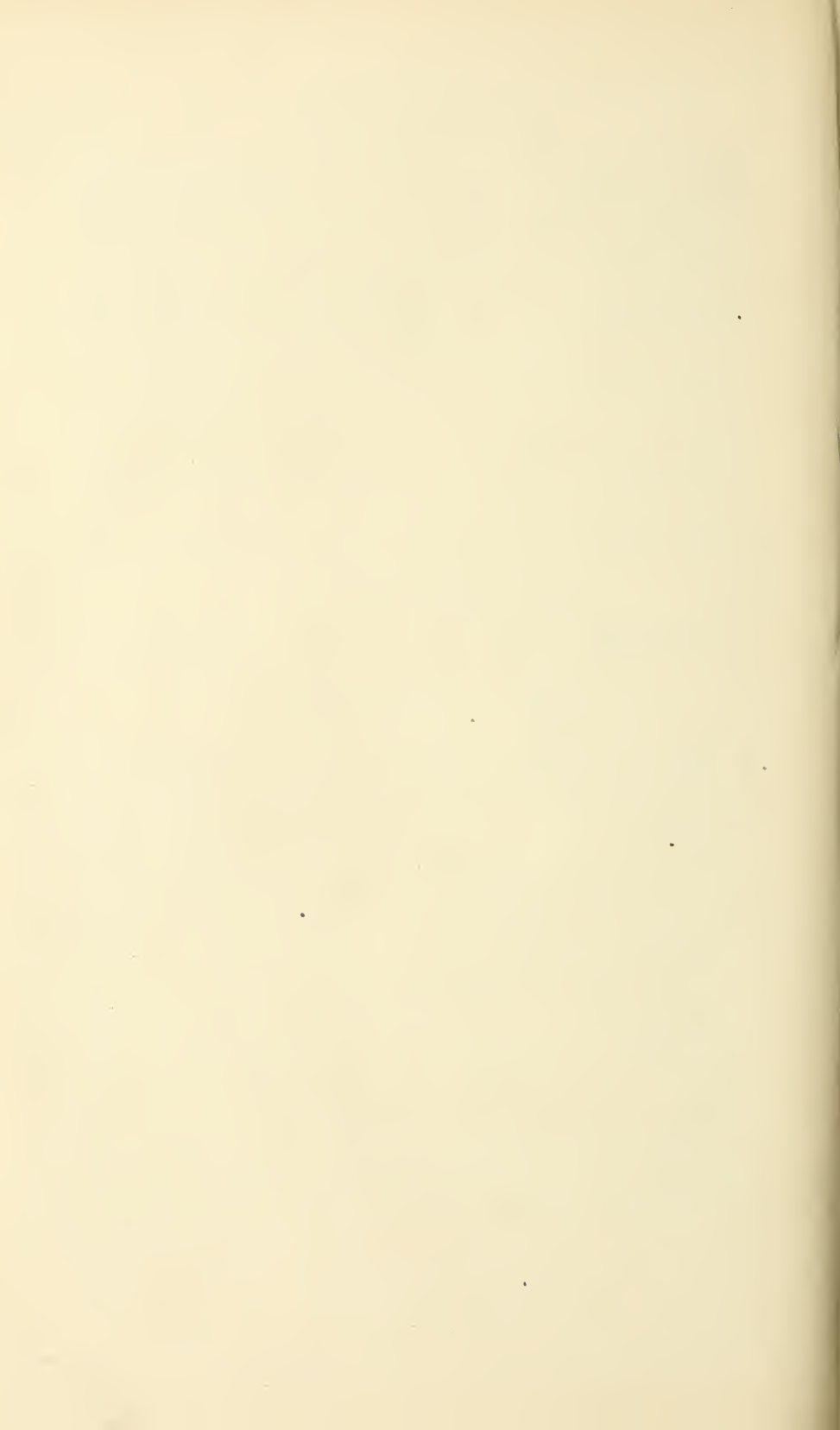
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NUMBERS 1 and 2

JUNE, 1913

BULLETIN
OF THE
Wisconsin Natural History
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MILWAUKEE, WISCONSIN

ORGANIZED MAY 6, 1857

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PAUL H. DERNEHL, Vice-President.....718 Majestic Building, Milwaukee
J. R. HEDDLE, General Secretary.....Public Museum, Milwaukee
HERMAN B. BECKMANN, Treasurer.....258 Ogden Ave., Milwaukee
HENRY L. WARD, Director.....Public Museum, Milwaukee

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The "Bulletin of the Wisconsin Natural History Society."

Matter intended for publication should be sent to the editor of the Bulletin, who will transmit it to the associate editor of the proper department for consideration.

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MEETINGS

Regular meetings are held on the last Thursday of each month, except July and August, in the trustees' room at the Public Museum Building, Milwaukee, and meetings of the combined sections on the second Thursday of each month, at the same place.

MEMBERSHIP DUES

Active Members, \$3.00 per annum; Junior Members, \$1.00 per annum; Corresponding Members, \$2.00 per annum; Life Members, one payment of \$50.00.

BULLETIN

OF THE

WISCONSIN NATURAL HISTORY SOCIETY

Vol. 11

JUNE, 1913.

Nos. 1 and 2

PROCEEDINGS

MILWAUKEE, WIS., May 30, 1912.

Annual meeting.

President Barth in the chair. Twenty persons present. Minutes of the last regular meeting read and approved.

Prof. I. N. Mitchell, of the State Normal School, gave the evening's lecture on "The Passenger Pigeon and Other Wisconsin Birds." This lecture was illustrated by numerous lantern slides and stuffed specimens. Professor Mitchell expressed the belief that the disappearance of the Passenger Pigeon was due to the wholesale shooting during the breeding season. He called attention to the indiscriminate shooting of hawks, many species of which are beneficial to man and should be protected.

The lecture was discussed by Mr. Russel, Mr. Ward, Mr. Teller and Dr. Dernehl. Mr. Russel moved that the Society be instructed to request the Biological Survey to supply copies of its bulletins dealing with hawks to the Marshfield gun, rod and pheasant breeding club, which has recently inaugurated a shooting campaign against all hawks, good, bad and indifferent. The motion was seconded and carried.

After the lecture, a recess was taken and then the business of the annual meeting was taken up. Ten members were present.

The report of the secretary was read and placed on file. The report of the treasurer was read and referred to the auditing committee, Drs. Dernehl and Barrett, who later reported the accounts correct. Dr. Dernehl then reported for the program committee for the regular meetings. He called attention to the meager attendance at these meetings. Mr. Ward moved that a vote of thanks and confidence be extended to Dr. Dernehl for his work on the programs for the past year. The motion was seconded and carried. All the members of the committee on the programs for section meetings being absent, the secretary reported for this committee.

The nominating committee then made its report through the chairman, Dr. Graenicher. All the old officers were renominated, the secretary, however, consenting to serve only until the meetings were over for the summer.

The following officers were elected:

President, Dr. G. P. Barth.

Vice-President, Dr. P. H. Dernehl.

Treasurer, Mr. H. B. Beckmann.

Secretary, Dr. R. G. Washburn.

Additional Director, Mr. H. L. Ward.

As a committee on the banquet to be held June 13, the following were appointed: Chairman, Mr. Howland Russel, Dr. P. H. McGovern and Mr. E. E. Teller. These three were instructed to act with the committee on section meetings.

Dr. Graenicher reported for the committee on botany and told of the work thus far done on a check list of Wisconsin plants.

The meeting then adjourned.

MILWAUKEE, WIS., June 13, 1912.

The annual banquet of the society was held at Hotel Blatz. Nineteen members were present.

MILWAUKEE, WIS., June 20, 1912.

Meeting of the combined sections.

President Barth in the chair. Eighteen members present. The president appointed Dr. Barrett as secretary pro tem.

The following matters of business were transacted: The application of Mr. J. R. Heddle for membership was received and referred to the Board of Directors for action. The resignation of Dr. Washburn as secretary of the society was read by the president. Upon motion of Mr. Teller, action upon the resignation was deferred until the next regular meeting.

The presentation of papers was next taken up.

Prof. Henry H. Severin of Honolulu, Hawaiian Islands, spoke upon the subject of certain destructive insect pests of these islands. Professor Severin took up in detail the four principal pests: (1) the Japanese beetle, (2) the sugar-cane borer, (3) the melon fly, and (4) the Mediterranean fruit-fly; speaking upon (1) the destructive effects, (2) the life-histories, (3) the economic relations, and (4) the methods of control of each of these insects. His lecture was illustrated by specimens and a series of lantern slides taken from his own experimental work in Hawaii.

Dr. Brinckley exhibited a specimen of marl and spoke upon its occurrence and economic value in Wisconsin.

Dr. Graenicher spoke upon the relation between certain plants and insects that inhabit the Lake Michigan dunes. He illustrated his remarks by means of specimens; and pointed out the interesting mingling of boreal and desert forms in these dunes, due to the very specialized environment there provided.

The members present joined in the discussion following the presentation of each paper.

The meeting then adjourned.

MILWAUKEE, WIS., October 10, 1912.

Meeting of the combined sections.

President Barth in the chair. Ten members present. Mr. Beckmann appointed secretary pro tem.

Various subjects discussed by the members.

Dr. Sherman presented some pods of a leguminous plant from Florida, for identification. The plant in question proved to be *Caesalpinia Bonducella*.

Mr. Russell reported the finding of the hackberry, *Celtis occidentalis*, in Ozaukee County; and mentioned the fact that this species had been also found in the northern part of Milwaukee County. Dr. Graenicher reported the same as occurring in La Crosse. Mr. Russel further reported the finding of two species of chestnut oaks, *Quercus Prinus* and *Q. Muhlenbergii*, near Big Bend; and of two specimens of Kentucky coffee-tree, *Gymnocladus dioica*, from the same locality. Mr. Mann reported the Kentucky coffee-tree for Racine County; Mr. Heddle, for Dane County.

Dr. Barth and Dr. Graenicher spoke of the occurrence of tulip-trees in the city of Milwaukee.

Dr. Barth gave observations on the habits of some wasps of the genus *Crabro*.

Mr. Mann remarked about the tendency shown by animals such as foxes, skunks and mice to draw closer to human habitation, in preference to living in uninhabited wilds. He suggested the explanation, namely, that food was more easily obtained in the former situations.

Some of the speakers' remarks were informally discussed by the members present.

The meeting then adjourned.

MILWAUKEE, WIS., November 14, 1912.

Meeting of the combined sections.

President Barth in the chair. Mr. J. R. Heddle appointed secretary pro tem. Fourteen people present. Minutes of last section meeting read and approved. The name of Mr. Walter C. Kraatz, Public Museum, was presented for active membership and was referred to the Board of Directors for action.

Mr. E. E. Teller spoke briefly on the occurrence of fossils in the limestone mounds about Milwaukee. He showed a number of interesting specimens. One, that of *Echinocystites nodosus*, collected about two miles north of the city limits, is the only specimen of the mold showing surface markings, that has been reported for the United States.

Mr. H. L. Ward gave an interesting account of a meteor that fell this summer in Arizona. He presented, for examination, a number of the fragments, which were picked up after the explosion of the meteoric mass. The angular and but slightly encrusted condition of these fragments, together with reports of eye witnesses, indicate that the meteor exploded not far from the surface of the earth. As to the number of pieces found, this meteoric fall is, with one exception, the most remarkable known. Several members discussed the paper.

Mr. Heddle exhibited specimens of plants from the herbarium of the Public Museum, which are recent additions to the reported flora of Milwaukee County.

Dr. Graenicher told of the progress of the committee on the check-list of Wisconsin plants, and said that the third section of the tentative check-list was in preparation. In reference to this plant census, he emphasized the need of more cooperation between institutions having collections of Wisconsin plants.

Mr. Scheiber and Drs. Graenicher and Barth discussed the possible connection of certain flies with the disease of infantile paralysis.

The meeting then adjourned.

MILWAUKEE, WIS., December 12, 1912.

Regular meeting of the society.

President Barth in the chair. Thirty persons present. Minutes of last section meeting read and approved.

Mr. J. R. Heddle was elected secretary in place of Dr. Washburn, whose resignation took effect at the beginning of the summer recess.

Mr. Ward presented for membership in the society, the names of Dr. Leon D. Peaslee and Mr. Cornell R. Smith, Public Museum, and of Dr. Arthur S. Pearse, Department of Zoology, University of Wisconsin. These names, together with that of Mr. W. C. Kraatz, Public Museum, were referred to the Board of Directors for action.

President Barth spoke about two bills that are to be put before the legislature: one, to increase the appropriation of the Wisconsin Geological and Natural History Survey; the other, to permit the more frequent publication of the Transactions of the Wisconsin Academy of Sciences, Arts and Letters. Mr. Russel then moved that the chair be empowered to appoint a committee of three to cooperate with the Wisconsin Academy in the passage of these bills. The motion was seconded and passed. The chair announced that the committee would be subsequently appointed.

The lecture for the evening was given by Prof. L. J. Cole, Professor of Experimental Breeding at the University of Wisconsin, on the subject: "Gregor Mendel and His Work."

1. The first part of the lecture was devoted to the personality of Mendel, his native town in Austria, and his life as student and investigator in the local monastery. Note the simplicity and strength of character of the man, his keenness of judgment, a true scientific spirit and devotion to scientific work, terminated only on his becoming abbot in the monastery.

2. Mendel's classic experiments and derived theories. His results were not given the amount of attention they more recently have received, due, not only to their publication in the proceedings of a local natural history society, but more especially to their appearance at about the same time Darwin's work was beginning to absorb the attention of the whole scientific world. Mendel died without realizing the true significance and the application of his results.

3. Confirmation and extension of Mendel's theories by later investigators. Mendel came very near explaining the true cause of his results, by suggesting the presence in the organisms, of certain hypothetical bodies, which transmit the hereditary characters. It is not probable that he

actually saw the chromosomes. Later investigations have shown, relative to the presence and absence theory, that which Mendel could not have seen, namely, that the characters of the round and the wrinkled seeds are accompanied by definite characteristics of the starch grains.

4. Application of Mendel's laws. The more we investigate, the more do we find confirmation of Mendel's laws. In some cases of breeding, the prediction of the results is now merely a question of mathematics. The Mendelian laws apply just as strongly to human beings, as to other organisms; e.g., the case of inherited weak-mindedness. We need a knowledge of these laws, to be guided aright in social affairs and in eugenics.

The first part of the lecture was illustrated by slides from pictures taken by Professor Cole, during his visit to Mendel's native town; the latter parts, by colored slides showing very graphically the actual plants, an improvement over the diagrams often used.

At the conclusion of a brief discussion of the lecture, Professor Cole was given a vote of thanks.

The meeting then adjourned.

MILWAUKEE, WIS., December 26, 1912.

Meeting of the combined sections.

President Barth in the chair. Seven members present. Minutes of last regular meeting read and approved.

The president brought for examination, a recent Russian publication, showing some remarkable stereoptican photographs of ants and their habitats.

Dr. S. Graenicher then gave an informal talk on the subject: "Occurrence and Geographic Distribution of Some Wisconsin Insects and Plants." He noted the occurrence of a cricket, *Diectrammena marmorata*, probably originally introduced from Japan, specimens of which species were found in a number of greenhouses about Milwaukee; the finding at the late date of November 19th (5:30 p.m., temperature about 55° F.), of the moth, *Euxoa ochrogaster*; and of the capture, in the Museum building of a single specimen of the large moth, *Erebus odora*, a decidedly southern species. Mr. Muttkowski reported the finding of four specimens of the latter moth in the vicinity of Milwaukee, and suggested their probable flight from the South.

Dr. Graenicher then correlated his observations on some boreal and southern species of Wisconsin plants and animals with the results obtained by Whitson and Baker (Bulletin 223, Wis. Agr. Exp. Sta.), who find that the Wisconsin crops are distributed according to thermal lines based on the temperature of the growing season. He finds the distribution of the few species observed to be generally in accordance with these lines, rather than with isotherms based on mean annual temperature, to which some authors have attributed the distribution of the *Orthoptera*. Messrs. Muttkowski, Russel and Smith discussed the paper.

Mr. Muttkowski suggested the problem of insect distribution consequent

on the differences of temperature to be observed in the lower and higher areas of woodlands, especially so at night.

The meeting then adjourned.

MILWAUKEE, WIS., January 16, 1913.

Meeting of the combined sections.

President Barth in the chair. Nine members present. Minutes of last section meeting read and approved.

Dr. Brinckley spoke of the advisability of having a definite topic of discussion for each section meeting.

Miss Flora Elmer brought for examination, a seed-pod of a Californian leguminous plant.

Discussion by Drs. Barth, Graenicher and Peaslee of several topics—game preserves, oaks of Wisconsin, and the brown-tail moth.

The meeting then adjourned.

MILWAUKEE, WIS., January 30, 1913.

Regular meeting of the Society.

President Barth in the chair. Forty-three persons present. Minutes of last section meeting read and approved. Order of business was reversed.

The lecture for the evening was given by Prof. I. N. Mitchell of the Milwaukee State Normal School, the subject being "A Florida Christmas." Professor Mitchell described in a very interesting manner, some of the forms of bird and plant life seen during a short vacation in Florida. He illustrated his remarks by means of numerous lantern slides. Among the northern birds observed were: the bob-white, woodpeckers, hermit thrush, red-winged blackbird and ruby-crowned kinglet. The robin was not seen; is said to be rare in Florida. Some of the botanical items noted were: the southern pine woods, scarcely dense enough to be called forests; the modern methods used in the turpentine industry; the presence of the date palm, the decorative giant yuccas, and the Spanish moss (*Tillandsia*) that festoons many of the trees; the orange groves with their bamboo wind-breaks; and the cypress swamps with their characteristic vegetation.

The secretary read a communication, which was received from Mr. C. J. Allen, wherein the aims of the Wisconsin Fish and Game Protective and Propagation League were set forth, and the invitation extended to the Society to become a member of the League. Mr. Allen, being present, told in more detail of the aims of this organization. A few of the states have already started game preserves and wild fowl refuges. Wisconsin needs such protected places and has the opportunity of being among the first states to take such measures for the protection of the wild life within its borders.

Dr. Burgess then spoke of the violation of the game laws, especially in the northern part of the State. The proper enforcement of these laws is a matter of education of the people—a creation of active local sentiment for game preservation. Drs. Barth and P. H. McGovern, Mr. Carpenter and Mr. Ward participated in the discussion following the above remarks.

On motion of Dr. McGovern, the president was empowered to appoint a committee of three to act in reference to the game preservation bills now before the legislature. The president appointed the following: Chairman, Mr. Allen, Dr. McGovern and Mr. Ward, and in addition, Dr. Burgess, to act with the committee.

On motion of Mr. Ward, the secretary was instructed to enter into correspondence with the local congressmen, in relation to the passage of the bills for the protection of non-game birds.

The meeting then adjourned.

OBSERVATIONS ON THE FAUNA OF THE ROCK BEACHES AT NAHANT, MASSACHUSETTS

BY A. S. PEARSE

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I. INTRODUCTION

Nahant is a peninsula which extends from the coast of Massachusetts into the Atlantic Ocean. It consists of two rock masses that have been "tied" to the main land by slender sandy strips. (fig. 1). The hard rock strata incline away from the ocean (fig. 2) in such a way that their erosion makes a rough wall which affords a favorable habitat for a very abundant fauna. Though the rocks are the chief point of interest at this locality, for the ecologist, ample opportunity is offered for comparison with other types of beaches, for the eastern side of the connecting strips is a clean sand exposed to the full sweep of the open ocean (fig. 1, 4.), and on the west side there are broad mud flats (fig. 1, 14).

This paper is an attempt to give a picture of the conditions at Nahant which may serve for comparison with beaches on other coasts. The data were gathered during the spring of 1912, though the writer had previously collected in this region and had a general familiarity with the fauna. From June 8 to 27 the writer was in the field daily from morning until evening. Careful notes

were taken concerning: exact location of animals and their habitat preferences, stomach contents, periods of activity, temperatures of water and air, direction of wind, and other points of interest. A microscope was used in the field to study the stomach contents of certain animals and to identify some species, but the

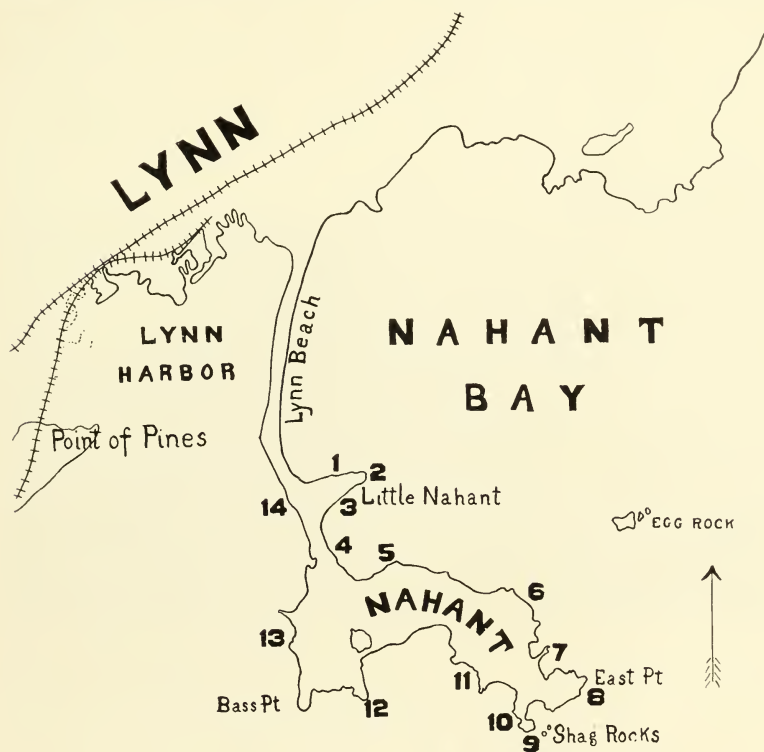


FIG. 1. MAP OF NAHANT, MASSACHUSETTS.

survey was for the most part macroscopic and no attempt was made to collect Protozoa or other minute organisms. The chief tools employed were pencil, notebook, and camera—no net or other collecting apparatus was used, but specimens that could not be identified at sight were preserved for future determination.¹

¹ Thanks are due to the following persons who were kind enough to identify specimens: I. F. Lewis, algae; C. C. Nutting, sertularians; J. P. Moore, annelids; W. R. Coe, nemerteans; R. C. Osborn, Bryozoa; F. N. Balch, nudibranchs; W. Chester, lamellibranchs; H. A. Pilsbury, barnacles; M. J. Rathbun, *Hyas*; N. Banks, arachnids, myriapods; A. N. Caudell, *Anisolabia*; W. S. Marshall, W. M. Wheeler, L. O. Howard, insects; W. G. Van Name, ascidians; G. Wagner, fish. The writer is also indebted to Prof. J. R. Roebuck who tested the thermometer used in taking temperatures.

At the time the observations were made, the season was not far advanced and the temperature was still somewhat cool—the ocean was once as low as $6.5^{\circ}\text{C}.$; the air varied from $11.8^{\circ}\text{C}.$ to $24.2^{\circ}\text{C}.$ Detailed observations were made at fourteen different stations, the locations of which are shown in figure 1.



FIG. 2. SHOWING ROCK BEACH AT STATION 8.

II. THE ROCK BEACHES

The rock beaches are subdivided into horizontal zones each of which is dominated by characteristic animals or plants. At most stations five such zones were readily recognisable: (1) the rocks and pools above the limits of high tide, (2) a zone populated almost entirely by *Balanus*, (3) *Ascophyllum* and *Balanus*, (4) *Fucus*, (5) *Chondrus*. The stratification at Nahant is more complete and differs somewhat in its characteristics from that described by King and Russell ('09) at Millport on the coast of Scotland. The zones will now be considered in order, beginning with the highest.

1. The Rocks above High Tide Mark

Perhaps the most characteristic animal in this region of bare rock was the fly, *Parydra* sp. (?). Spiders and ants commonly foraged here, beetles were not infrequent, and occasionally *Anisolabia* or a myriapod was seen skulking into a fissure. Where boulders afforded shelter rats were often seen to come out to feed at low tide. Besides *Parydra*, butterflies, dragon-flies, mosquitoes, and damsel-flies frequented the air above.

The little pools in the hollows of the rock often supported an abundant fauna. *Corixa*, *Notonecta*, *Culex* larvae, toad tadpoles, amphipods, cladocera, copepods, and chironomid larvae frequently occurred in great numbers with *Enteromorpha* or *Cladophora* in fairly fresh water. *Parydra* bred in these puddles and collected on the surface in such numbers that it formed rafts several inches across. Near the ocean where spray collected in depressions, barnacles, *Littorina*, *Mytilus*, *Corallina* and other marine organisms obtained a foothold and maintained themselves.

In some cases there was a definite stratification of the water in rock depressions and both marine and fresh water animals were able to exist in the same pool. Toad tadpoles, *Corixa*, Chironomid and *Culex* larvae were found in the same basin with living barnacles, rock crabs and *Littorina*. The stratification leads to curious temperature relation for when the sun shines on the rock, the heavier salty water at the bottom is raised to a higher temperature than that near the surface. In one pool ten inches deep the top and bottom temperatures (of the water—the thermometer was not permitted to rest on the bottom) were 15.7° C. and 23.5° C. respectively; in another, 17.7° C. and 24.0° C. At Station 6 (fig. 1) where fresh water seeped through the rocks there were several pools just above high tide mark which had a typically marine fauna at the bottom (*Littorina*, *Corallina*, *Carcinides*, *Balanus*, *Jaera*), and freshwater animals above (tadpoles, *Corixa*, dipterous larvae). In pools in the barnacle zone just below these there were few or no barnacles for about one inch below the surface of the water, though they were abundant on the rocks above and in the deeper parts of the pools.

The bare rocks above the limits of high tide are clearly under

the domination of the ocean, for lichens, crickets, and other organisms that frequent rocky places in the fields further from the shore are wholly lacking.

2. The *Balanus* Zone

In this stratum, where the exposure and variation are greater than anywhere else on the beach, algae are absent, and "acorn" barnacles (*Balanus*) greatly exceed all other animals in abundance



FIG. 3. *Balanus* ON VERTICAL ROCK WALL.

(fig. 3). *Mytilus* occurs in protected crevices, however, clear to the top of the barnacle zone; *Littorina litorea* is found in similar situations (fig. 4, 5) and *L. rudis* often occurs on the bare rocks above the barnacles. *Anurida* breeds in empty barnacle shells. In the pools of this zone dipterous larvae, *Mytilus*, *Carcinides*, *Gammarus locusta*, *Idothea baltica*, *Balanus*, *Parydra*, *Littorina litorea*, and *L. rudis* were often common; also *Campanula* and *Sagartia* in protected situations.



FIG. 4. *Littorina* IN A CREVICE JUST ABOVE ASCOPHYLLUM ZONE.



FIG. 5. SHOWING *Littorina* AND *Purpura* ON ROCK WALL.

3. The *Ascophyllum* Zone

Balanus was abundant in this zone as in the one just above, but the most important environmental factor was the *Ascophyllum* which hung in long tufts (fig. 6) from the rocks and gave shelter to an abundant fauna. The most characteristic animal which grew attached to this alga was *Sertularia pumila* which covered the fronds (fig. 7) in protected situations; in exposed places it was largely replaced by the alga, *Polysiphonia fastigiata* Grev.



FIG. 6. SHOWING AN ALGA-COVERED ROCK FACE AT STATION 9.

There is no *Fucus* except where the tide spurts through a narrow fissure (*f*); *Ascophyllum* (*a*) replaces it on the protected surfaces. The *Balanus* zone (*b*) is above the *Ascophyllum*.

(fig. 8). At the bases of the plants various Bryozoa and *Clava* often formed a coating.

Many animals found shelter or fed among the fronds of *Ascophyllum* when the tide was out. Among these *Bella*, nemerteans, nematodes, *Carcinides*, and amphipods (*Grammarus locusta*, *G. marinus*, *Allorchestes*, *Amphithoe*) were regular residents. *Ophiopolis*, *Hyas*, and *Strongylocentrotus* were each found only once and evidently belonged to a deeper stratum. At night and on



FIG. 7. SHOWING *Sertularia pumila* GROWING ON DEEPER LAYERS OF *Ascophyllum*, WHICH IS HELD ASIDE AT THE RIGHT.



FIG. 8. *Polysiphonia fastigiata* GROWING ON *Ascophyllum*. *Cancer borealis* IN A CREVICE.

rainy days the rock- and Jonah-crabs (*Cancer*) came up to feed (fig. 8); crane-flies, *Parydra*, and beetles were of frequent occurrence.

Beneath the shelter afforded by the matted algae many animals attached themselves to the rocks. Anemones replaced the barnacles in many places (fig. 9) and often formed veritable carpets in little crevices; *Clava* sometimes did the same. *Sagartia* was found at higher levels than *Metridium*. *Purpura* and its egg cases



FIG. 9. *Metridium marginatum* GROWING ON ROCKS WITH *Balanus*, *Mytilus*, ETC., BENEATH *Ascophyllum*.

(figs. 10, 11) were abundant on vertical walls or under overhanging shelves. The ubiquitous *Mytilus* and *Littorina litorea* were everywhere; *Littorina palliata* and *Acmaea* (fig. 11) were less common. Sertularia commonly grew attached to the rock and in exposed localities, like Station 8. *Obelia*, *Bryozoa* and *Chondrus* crept up under the *Ascophyllum* from the strata below. Small Nemerteans swarmed in this zone at Station 9. *Modiola* was often encountered at the lower edge of the *Ascophyllum*.



FIG. 10. *Purpura lapillus* WITH ONE OF ITS OWN EGG CASES ATTACHED TO ITS SHELL (ABOVE). GENERAL VIEW OF SAME SPECIES WITH ITS EGG CASES BENEATH *Ascophyllum*.



FIG. 11. *Purpura lapillus* AND ITS CLUSTERS OF EGG CASES IN CREVICES BENEATH *ASCOPHYLLUM*. *ACMAEA TESTUDINALIS* IN LOWER CORNER.



FIG. 12. EXPOSED ROCKS AT STATION 2 COVERED WITH SHORT *Fucus*, *Mytilus*, AND *Balanus*.



FIG. 13. SHOWING *Fucus* REPLACED BY *Mytilus* ON A ROCK FACE EXPOSED TO WAVE ACTION.

4. The *Fucus* Zone

The *Fucus* Zone was present just below the *Ascophyllum* in exposed situations but dropped out completely in protected bays (Fig. 6) and was itself replaced by *Mytilus* and *Balanus* on isolated wave-beaten rocks, (figs. 12, 13, 14). The most characteristic animals were *Mytilus*, *Balanus*, and *Acmaea*; others which commonly occurred were *Purpura*, *Littorina litorea* and *L. palliata*, *Asterias*, *Clinoa*, *Allorchestes*, *Cancer borealis*, *Pagurus pubescens*, and *Pholis*. *Jassa* was found in this zone, always in *Cladophora arctica*.



FIG. 14. SHOWING EXPOSED ROCKS AT EAST POINT (STATION 8).

The left side is toward the open ocean. The *Ascophyllum* (a) and *Fucus* (f) pinch out and are replaced by *Balanus* (b).

5. The *Chondrus* Zone

Chondrus crispus, commonly known as "Chagreen" or "Irish Moss" formed a thick carpet on the rocks from a little above low tide mark to a considerable depth. Here, as in the *Ascophyllum* zone, the vegetation sheltered a great variety of animals; in fact, more species were found than in any other zone. Probably the most characteristic animals were *Idothea baltica*, *Acmaea*, *Asterias*

(fig. 15), *Cancer borealis*, *Metridium*, and *Bryozoa*; though *Mytilus* (fig. 16), *Balanus*, and *Littorina litorea* were abundant, as elsewhere. On June 13 thirty-seven individuals of *Cancer borealis* were counted on several *Chondrus*-covered rocks in a space thirty by fifteen feet at Station 12. *Idothea* often had a deep purplish-red color which matched the *Chondrus* very closely. Other animals that were more or less common in the Irish Moss at low tide were: *Cliona*, *Campanula*, *Sertularia*, *Littorina palliata* (sometimes,



FIG. 15. *Asterias forbesi* ON *Chondrus*.

L. rudis), *Purpura*, *Orchestia*, *Gamarellus*, *Amphithoë*, *Jassa* (in *Cladophora arctica*), *Carcinides*, *Cancer irroratus*.

The larger pools in this zone with a rich growth of *Corallina*, *Laminaria* and other large algae, contained many animals that were not found elsewhere. Here *Metridium* attained enormous size (more than 6 inches in diameter), *Littorina litorea* was larger than in other habitats, and giant *Asterias* abounded. Other residents were *Modiola*, *Cliona*, *Carcinides*, *Bryozoa*, *Strongylocentrotus*, *Henricia*, *Botryllus*, *Tubularia*, nudibranchs, *Pagurus*, *Jaera*, *Chiton*, *Acmaea*, and *Saxicava*. Among the small stones and

"roots" of the laminarians were many worms (*Lepidonotus*, *Harmothoë*, *Phyllodoce*, *Nereis pelagica*), and the brittle-star, *Ophiopholis*.

6. Inter-relations of the Zones

Zonation in the distribution of plants or animals means that the struggle for existence is so severe that each species is kept rather close to optimum conditions, either by the "physical en-



FIG. 16. *Mytilus edulis*, *Balanus*, AND *Cancer borealis* IN CHONDRUS ZONE.

vironment" or by competition. When conditions vary, zones will vary. In the rock beaches at Nahant we accordingly find particular strata spreading when the conditions are favorable and "pinching out" when the struggle becomes too severe. The chief factors which cause zonal variations are: (1) degree of exposure to the open ocean, to the sun, or to winds; (2) the slope of the beach; (3) the character of the surface (smooth, rough, boulders, loose stones, etc.).

Proximity to the open sea (with low comparatively uniform temperature and purer water) is a favorable factor for there is

a greater variety of species and more individuals occurred at Stations 7, 8 and 9 (fig. 1) than elsewhere. Exposure to wind causes the algae to give place to *Mytilus* and *Balanus*—which are better suited to stand the beating of the waves (figs. 12, 13, 14, Stations 2, 9 and 8). Sunlight is of course necessary for the growth of algae and at Station 1, where vertical cliffs have a northern exposure, the *Ascophyllum* zone is nearly absent. The effect of the slope of the rock is bound up somewhat with the character of its surface, but in general the more nearly vertical



FIG. 17. SHOWING THE ABUNDANCE OF *Littorina littorea* AND *Balanus* ON A ROCK WHEN BOULDERS ARE PRESENT.

a cliff, the more abundant is its fauna in individuals and the more limited in species. At Station 2 a gentle smooth slope was exposed to the full sweep of the waves and was nearly bare; whereas a rough beach near it with a similar slope and exposure was completely covered with *Balanus*, *Mytilus*, *Chondrus*, *Fucus*, etc. Boulders or crevices greatly increase the abundance of the fauna (fig. 17) and cause all the zones to migrate upward. Exposure to the ocean also causes all the zones to seek a higher level (fig. 18).

The variations in the zones might be dwelt upon at some length, but it is perhaps sufficient to point out that the tension is so great that every variation causes a ready adjustment.

7. *Characteristics of the Fauna of the Rock Beaches*

Probably no other animal habitat is subject to such a wide range of fluctuations in environmental conditions as the rock beaches along the ocean. The flora and fauna must endure the



FIG. 18. SHOWS THE EFFECT OF EXPOSURE TO THE OPEN SEA.

The picture is of the back of a rock-wall that ran parallel with the shore. The *Ascophyllum* hanging through a crevice from the exposed side of the wall is above the upper limit of the barnacles on the side away from the ocean. Proximity to the ocean permits organisms to climb higher on the rocks.

frigid span of winter and the blistering sun of summer. There is no escape, the tide keeps up its eternal rhythm and the organisms are left exposed to the elements every time the water recedes. The exposure of the hard substratum to sun, wind, and wave has developed a fauna which consists largely of animals that are: (1) attached permanently or have well developed clinging organs;

(2) they may be active and hard-shelled, or (3) small and ubiquitous; (4) most of them are very hardy and can stand considerable exposure.

The ability to cling to a hard surface is of prime importance on a rock beach and in the most exposed situations those organisms survive which are best able to hold on (figs. 13, 14). The shapes and methods of attachment of *Fucus*, *Mytilus*, *Acmaea*, and *Balanus* are admirably suited to withstand the force of waves and these genera succumb in the order given (*Balanus* being the first to cover a clean exposed rock surface and the last to leave it).

The snails, *Littorina* and *Purpura*, are not far behind these hardy pioneers; and the attached coelenterates, like *Metridium*,

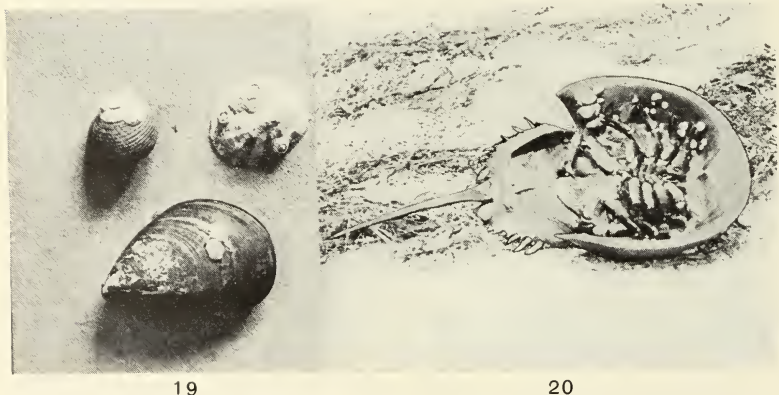


FIG. 19. *Balanus* ATTACHED TO *Littorina litorea*, *Acmaea testudinalis*, AND *Mytilus edulis*.

FIG. 20. *Limulus polyphemus* BEARING *Crepridula fornicata* AND *C. plana*.

Sagartia, and hydroids, are also well suited to life on the rocks. The distribution of some animals is apparently limited only by the presence of something hard for attachment; *Mytilus* is abundant on the rocks everywhere—even on the mud flats; *Littorina* is common on the firmer portions of sand beaches. Often one sessile animal is fixed to another (fig. 19).

Representative examples of the active hard-shelled animals are the crabs, *Cancer borealis*, *C. irroratus*, *Carcinides maenas*, and *Pagurus pubescens*. All these species are able to withstand considerable beating by the waves, yet they can escape exposure to the sun by migrating downward with the receding tide.

Of the small ubiquitous motile animals the amphipods, isopods, and worms may be cited as examples. They are protected by their ability to hide under sea weeds or in crevices when the tide recedes. They occur in great abundance and become active when the ocean periodically covers them.

The large, hard-shelled crabs which migrate back and forth from deeper to shallow water bring up many attached organisms on the shore which are characteristic of deeper water. *Crepidula* is abundant on shells and stones in deep water but was observed in shallow water only on *Limulus* (fig. 20), in the shells of *Pagurus* (fig. 21a) and on *Cancer* (fig. 22). *Spirobis* was found only on *Fucus* and *Laminaria* in open water, in *Pagurus* shells (fig. 21 c), and on crabs. *Hydractinia* occurred in the most exposed localities

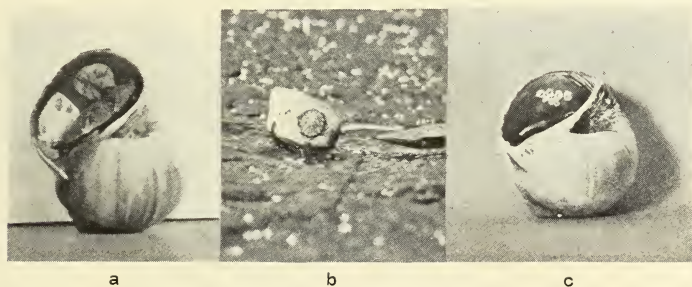


FIG. 21. a, *Pagurus acadianus* IN A *Polynesces heros* SHELL WITH *Crepidula plana*; b, *Acmaea testudinalis* ATTACHED TO *Littorina litorea*; c, *Pagurus acadianus* IN A *Polynesces heros* SHELL WITH *Spirobis spirorbis*.

on rock, algae, and barnacles, but also coated many *Pagurus* shells. *Hydroides* was never seen on the beaches except on the carapace of *Cancer borealis*. Attachment to a moving object is probably of considerable advantage to these small animals, yet, though such association has come to be quite constant in some cases (e.g., *Pagurus* and *Hydractinia*), their association with particular large animals is usually more or less accidental.

Considering the frequency with which small sessile animals occur attached to larger forms it is not hard to imagine how a barnacle might have become modified into a *Sacculina*-like animal or how a sessile mollusc might have been transformed into a parasite. One *Cancer borealis* (fig. 22) captured at Station 8 (fig. 1) bore the following fauna: on dorsal surface of carapace, *Spirobis*

and an alga (*Hildenbrandtia*); on right side anterior to legs, a *Crepidula plana* with its eggs; on legs, *Spirorbis* and a small *Crepidula*; under abdomen, three *Mytili* (one large, two small).

But we are perhaps dwelling over long on the relations of certain sessile animals to others. Let us pass on to consider the marked sedentary character of the animals on the rock beaches. Not only were many of the animals permanently attached, but a number of those which had well developed powers of locomotion often remained for long periods of time fixed in one spot. *Asterias*, *Littorina*, crabs and ribbon-fish (*Pholis*) migrated up and down with the tides more or less, but *Acmaea*, *Strongylocentrotus* and *Metridium* sometimes remained for at least a fortnight in one



FIG. 22. VENTRAL VIEW OF A *Cancer borealis*

that bore the following fauna: On the dorsal surface of carapace, *Spirorbis spirorbis* (and an alga, *Hildenbrandtia*); on left side anterior to legs a *Crepidula plana* with its eggs; on right side, a small *Mytilus edulis*; on legs, *Spirorbis* and a small *Crepidula*; on swimmerets—three *Mytili* (one large, two small).

FIG. 23. *Hydractinia polyclina* ON A *Littorina* SHELL OCCUPIED BY A HERMIT CRAB, AND ON A *Balanus*.

spot. Several different areas in the bottoms of pools were mapped and observed for two weeks to determine how much the animals moved from time to time. Most *Strongylocentroti* moved a little every time the tide covered them, though some were quiet two or three days, and one individual that was imbedded in a sort of a nest in a sponge (*Cliona*) (fig. 24) did not move for two weeks. *Acmaea* usually moved a little from time to time but few went out of the areas watched (5 to 6 ft.) during the period of observation; only one individual retained the same place and position for more than seven days. No "scars" such as have been described for *Patella* and other molluscs (Willcox, '05) were observed.

Metridium, though it has well developed powers of locomotion (MacClendon, '06) did not move appreciably; two colonies near the low water mark were mapped, but none could positively be said to have moved after two weeks, though eighty-four individuals were under observation.

It has been said that the rock beach fauna is a hardy one, and indeed it is to be expected that animals which are subjected to such variable conditions would develop considerable resistance.

At Nahant the tides rise and fall through a vertical distance of about eight feet. Those animals which do not migrate are alternately subjected to submergence under the cool waters of



FIG. 24. *Strongylocentrotus dröbachiensis* IN A "NEST" FORMED BY THE GROWTH OF THE SPONGE, *Cliona sulphurea* AROUND IT.

the ocean and to dessication under the direct rays of the sun. *Fucus* and *Ascophyllum* often become so dry that they crackle and break when touched, but they are apparently uninjured by such dessication and soon become pliable when wet by the rising water. A calcareous exoskeleton is characteristic of many inhabitants of the beach and doubtless affords adequate protection for their soft bodies against dessication and the extremes of temperature. *Balanus* and *Mytilus* seem to suffer no inconvenience from being baked by the sun, for they begin to feed within a minute after they are covered by the cool water of the rising ocean. *Littorina* has a similar resistance, and is influenced by the surface film as Haseman ('11) well demonstrated.

On the other hand soft bodied animals without any skeleton are often able to stand dessication and marked changes in temperature without apparent harm. On one occasion a *Metridium* was left exposed to the direct rays of the sun on a vertical rock surface, because the seaweeds which usually covered it had been left in an unusual position by the falling tide. A thermometer beside it registered 23.4°C . and it was thus exposed for at least three hours; at the end of that time it was covered by the ocean (7.9°C .) and at



FIG. 25. SHOWING SEVERAL ANEMONES, *Metridium marginatum*, LEFT OUT OF WATER AT A LOW TIDE.

Six with their bodies more or less expanded are in the lower left hand corner; one expanded individual (white) is in the center of the picture just above the light mass of *Chondrus*; three contracted individuals are at the surface of the water on the right side.

once extended its tentacles. Five days later this individual was in the same position and apparently in good condition. *Metridia* were often observed to be exposed (fig. 25) under similar conditions. The body was usually extended and filled with water; the tentacles were contracted.

The food relations of the animals on the rock beaches were studied as fully as possible and notes concerning food habits

will be found in the annotated list of species. Many species feed on the microscopic organisms that swarm in the littoral water (sponges, clams, coelenterates, Bryozoa, barnacles, ascidians, etc.); others devour the algae which grow on the rocks (*Strongylocentrotus*, nudibranchs, *Idothea*); a number of the larger species feed on smaller animals (*Asterias*, pycnogonids, ribbon fish, spiders, ants, sandpiper, etc.); several are scavengers (beetles, flies, worms, crabs, rats). Both plant and animal food are abundant. It is interesting to note that at least two of the larger predaceous animals (*Pholis*, crabs) eat barnacles, which constitute the most abundant animal food.

It is noteworthy that those animals which show the greatest development of the characteristics enumerated above have the widest distribution in the different zones and occur in the greatest numbers. *Balanus*, which combines with its firm fixation, the ability to capture food anywhere that sea water comes, and a remarkable resistance to changes in temperature, is everywhere. *Mytilus* and *Littorina* are almost as ubiquitous. The most abundant animals are those which feed on microscopic organisms or minute organic particles.

From the foregoing discussion it is apparent that the rock beaches at Nahant are a royal battle ground for the lower animals. The surface of the rock is a veritable sieve through which the microscopic organic content of the water disappears. The barnacles sweep it constantly with their fishing nets; the carpets of clams siphon food into their depths from the turbid water; *Littorinas* search every square inch and sweep it clean; wherever there is sufficient moisture the coelenterates and bryozoans spread their delicate tentacles to seize their share. Such abundant inhabitants with the algae furnish food for the less common larger animals; their refuse supports a host of lowly saprophytic organisms and scavengers. The keen competition for place and food, the abundance of life and its various forms makes one willing to believe that here indeed did organic matter have its origin.

III. THE SAND BEACH

The sand beach at Nahant (fig. 1, Station 4) was of interest because it showed a zonal arrangement in the distribution of animals without the presence of large algae, though microscopic

forms were doubtless present in the sand (Warming '09, p. 175). Six zones were distinguishable as follows (fig. 26):

1. The line of drift at the highest mark left by the water. Here the "beach-combers" *Orchestia*, *Talorchestia*, spiders, flies and beetles were found.

2. The gently sloping beach below was partly covered at high tide. Its only inhabitants were the two burrowing semiterrestrial amphipods, *Orchestia* and *Talorchestia*, and the agile tiger beetles.

3. *Chiridotea* swarmed on the rather flat ripple-marked beach nearer the ocean, and in the little puddles at this level a few *Littorina litorea* clung to the firm sand.

4. On the compact arched beach just below *Chiridotea* was not so common. Here *Polineces* made its appearance, though no individuals were as large as those in Zone 6 (fig. 26).

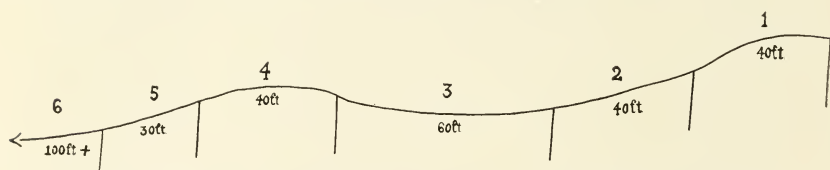


FIG. 26. A SECTIONAL VIEW OF THE SAND BEACH AT STATION 4 (FIG. 1.) SHOWING THE ZONES.

5. The rapid slope of this beach did not permit sand to collect; it consisted of pebbles, stones, and shells. No animals were seen.

6. The gently sloping expanse of sand that could be followed for more than a hundred feet by wading at low tide gradually descended into deeper water. Its fauna was more varied than that of any of the zones above. On its ripple marked surface *Polineces* was common and often attained a length of four inches. *Pagurus acadianus* (often bearing *Hydractinia*, *Spirorbis*, or *Crepidula*), *Crago*, and *Cancer irroratus* wandered over the surface of the sand. The *Cragos* captured were all adult females carrying eggs. In the shallow water *Idothea baltica*, *Calliopius*, *Gammarus annulatus*, and fish hunted for food. These animals migrated to higher levels with the rising tide. Burrowing in the sand were found: *Polineces*, *Nephtys*, *Echinarachnius*, and *Venus*. *Cyanea* was often stranded on the beach or pulsated slowly in the shallow water.

The fauna of the sand beach is composed largely of burrowing animals and ability to penetrate the shifting substratum is often combined with a heavy body. However, an important part of this fauna consists of more or less pelagic animals which frequent the shore water or come in from open ocean. The pelagic species are the same for the most part as those found on the rock beaches.



FIG. 27. *Polynices heros* (x) BURROWING IN THE SAND AFTER BEING LEFT BY THE SIDE.

Some excavated sand has been removed to show the snail.

IV. THE MUD FLATS

The mud flats at Station 14 (fig. 1) showed a gradual transition from rather clean sand at the top to soft black mud in the deeper parts. A few boulders and stones were scattered all through, except in the softest mud. Five zones (fig. 28) were distinguished but they were much less sharply marked than those on the rocks or sand beaches. They were as follows:

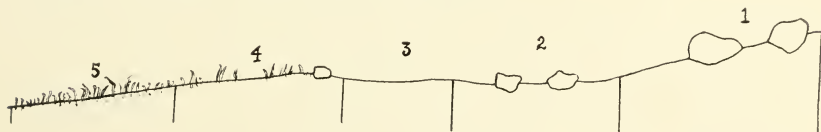


FIG. 28. SECTION OF MUD BEACH AT STATION 14 (FIG. 1) SHOWING ZONES.

1. It was noticeable that the rocks and boulders at the top of the beach were bare of algae. A few stunted tufts of *Ascomyllum* occasionally appeared; *Fucus* was wholly lacking (fig. 29). The ubiquitous barnacles and *Littorina litorea* were abundant on the rocks, and *Carcinides maenas* hunted among the stones.

2. On the sandy mud below the large boulders *Mya*, young and adult, was abundant. *Nereis virens* lurked beneath the stones which supported *Balanus*, *Mytilus*, and *Littorina litorea*. The latter also wandered freely over the rather firm beach between the stones. *Carcinides* was common everywhere. Floating eel-grass or other debris was often stranded here in considerable quantity.

3. Beyond the small stones and boulders there was a rather barren stretch of beach with occasional tufts of small ulva-like alga which grew attached to little pebbles. *Carcinides* and *Idothea* occurred here.



FIG. 29. THE TOP OF THE MUD BEACH AT STATION 14 (FIG. 1), SHOWING THE ABSENCE OF ALGAE ON THE ROCKS.

4. Next came a zone of scattered eel-grass. *Nassa* and its egg cases was abundant in certain places; *Mytilus* formed enormous beds; *Littorina litorea* clung to the eel-grass or any other available object (fig. 30); *Carcinides* of large size were abundant everywhere; *Cancer irroratus* was occasionally seen. The mud was filled with a little worm (*Lumbriconereis*?) which formed long tubes. *Limulus* (fig. 31) was breeding at the time the observations were made. Many mollusc shells were neatly perforated—the work of boring snails.

5. The lower parts of the flats supported a thick growth of eel-grass. The dominant animal here was *Carcinides*; many large females with eggs were seen. *Littorina litorea* was abundant; *Crago* (females bearing eggs), *Limulus*, *Idothea baltica*, *Jaera*, and

Cancer irroratus were also common. *Mytilus* formed large beds. Many drilled shells were strewn about; *Polineces heros* was represented among these, though none of this species was seen alive.

The surface of the mud flats became very hot when the sun beat down upon it at low tide. Many animals crawled under the eel-grass for shelter or burrowed in the sand (*Nassa*). *Carcinides* often burrowed and emerged again with a little disc of moist sand on its back thus securing protection from the direct rays of the sun.

Except for certain worms, *Mya*, and *Limulus*, no species is found on the mud flats that does not appear on other beaches. The dominant animals are *Carcinides*, *Littorina litorea*, *Mytilus*, *Crago*, and *Lumbriconereis* (?). All but the last two are numerous on the rock beaches. The only abundant organisms that do not



30



31

FIG. 30. PART OF A DEAD LOBSTER COVERED WITH *Littorina litorea*; ON THE MUD FLAT.

FIG. 31. *Limulus polyphemus*.

The female has excavated a hole and the male waits above her to fertilize the eggs she will lay.

occur on both the rock and mud are the large littoral algae, sponges, hydroids, and Bryozoa, which are absent from the latter. The dropping out of certain animals on mud flats is doubtless due to the lack of suitable objects for attachment and the comparative impurity of the water. The animals that are unable to live above the mud, like crabs and *Littorina*, have special arrangements for respiration (*Mya*, *Nassa*), except the worms whose soft bodies makes aeration of the internal fluids easy.

V. COMPARISON OF THE FAUNAS OF THE DIFFERENT BEACHES

At Nahant certain species are found everywhere between the tide marks provided they can find a suitable substratum. *Balanus*, *Littorina litorea*, *Mytilus edulus*, *Idothea baltica* and certain amphipods are examples of such hardy ubiquitous species—yet the first three are absent from the shifting sand beaches because there are no solid objects. The rock beaches have the largest number of species because they give ample shelter, solid substratum for attachment, pure cool water, and abundant food. Those animals that are unable to maintain themselves in the comparatively impure water on the mud flats drop out. Though a few characteristic species (*Mya arenaria*, *Limulus polyphemus*, *Lumbriconereis* (?) come in to take their places, the great bulk of the fauna consists of the ubiquitous hardy forms also present on the rock beaches.

Sandy shores have the most characteristic fauna of any of the beaches. *Idothea baltica* and certain amphipods are the only abundant animals present that are found in other situations. A large part of the population is made up of animals that are particularly suited to life in the sand: (*Polydora heros*, *Echinarachnius parma*, *Venus mercenaria*, *Chiridotea caeca*).

[To be concluded]

ZOOLOGICAL LABORATORY,
University of Wisconsin,
June 12, 1913.

A FEW NEW CHALCIDOID HYMENOPTERA FROM QUEENSLAND, AUSTRALIA.

BY A. A. GIRAULT

DIRHININI

Eniacella, new genus

♂: Like *Eniaca* Kirby, but the antennae 14-jointed with two short ring-joints, the club 3-jointed. Postmarginal and stigmal veins very short, the latter sessile. Posterior femora beneath with comblike teeth preceded by a single moderate sized tooth. Abdominal petiole short. Metathorax with teeth laterally and ventrally.

♀: Not known.

Type: *Eniacella ruficornis* n. sp.

1. *Eniacella ruficornis* new species.

♂: Length, 3.85 mm.

Black, the antennal and first two pairs of legs reddish, the posterior legs black, all tarsi yellow. Fore wings stained. Punctate. Scutellum simple. Tegulae reddish.

From one specimen $\frac{2}{3}$ -inch objective, 1-inch optic Bausch and Lomb.

From one male captured by sweeping foliage and grass along the banks of the Mulgrave River (jungle growth) adjoining cultivated fields, Nelson, Queensland, April 2, 1918.

Habitat: Australia—Nelson (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a tag (head accidentally lost.)

EUPELMINI

Neanastatus new genus

Type: The following species: *Neanastatus cinctiventris* n. sp.

1. *Neanastatus cinctiventris*, new species.

♀: Length, 2.75 to 3.50 mm.

Dark metallic green marked with bright lemon yellow as follows: Base of abdomen encircled with a band just out from base; scutum with a long rectangular area down its center; cephalic legs, intermediate legs except most of coxae and the coxae of the posterior legs, the posterior femora and tibiae and the distal four tarsal joints bluish to black, the distal joints of other tarsi black. Forewings with a deep smoky subrectangular area

under the venation, its middle at the stigmal vein; marginal and submarginal veins not differentiated, very long, the stigmal well developed, the postmarginal very long, thrice or more the length of the stigmal. A long oblique hairless line running cephalo-distad toward base of stigmal vein but not reaching it for some distance. Intermediate tibial spurs as long as the tarsi of these legs, stout, spiny, at apex ending in several stout spines. Scutellum with a broad base and a median groove. Eyes with very sparse pubescence. Antennae 10-jointed, with one ring-joint, the club 2-jointed. First funicle joint longest, the others shortening, the distal two subequal to each other and to the pedicel. Distal club joint subequal to first funicle joint. Head with dense but rather small thimble punctures, subtriangular, only as wide as the greatest width of the thorax, the vertex broad, the eyes not large, not convergent, the genal sulcus distinct; mandibles tridentate. Antennae inserted below the eyes. Thorax and abdomen polygonally sculptured. Antenna brownish yellow. Ovipositor not exerted.

From six specimens, similarly magnified.

♂: Not known.

From six females captured by sweeping the foliage of jungle growth along the banks of the Mulgrave River near Nelson, North Queensland, March 30, 1913.

Habitat: Australia—Nelson (Cairns), Queensland.

Types: In the Queensland Museum, Brisbane, two of the above specimens on tags (2 pins).

This new genus will be recognized because of the reduced number of antennal joints and the long postmarginal vein.

EULOPHIDAE—OMPHALINI

Epichrysocharis, new genus

♀: Like *Chrysocharis* Foerster but the postmarginal vein not at all developed; antennae 9-jointed with one ring-joint, the club joints three, the third obscurely articulated and not terminating in a spur-like seta. Scutum with a median grooved line. Marginal vein slightly shorter than the submarginal. Scutellum with two median grooved lines. Legs short, normal. Stigmal vein long.

♂: Not known

Type: *Epichrysocharis fusca* n. sp.

1. *Epichrysocharis fusca* new species.

♀: Length, 0.70 mm.

Dusky yellow, the scutum yellow; legs and antennae pale yellow; wings hyaline. Pedicel longer than any of the funicle joints, the third of the latter smallest, transverse, the first longest but wider than long. Ring-joint very minute. Fore wings densely ciliate. Impunctate.

From one specimen, similarly magnified; also high power.

♂: Not known.

From one female mounted in balsam, captured from a window at Nelson, N. Q., March 20, 1913.

Habitat: Australia—Nelson (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a slide.

Achrysocharis Girault MS.

1. **Achrysocharis grandis**, new species.

♀: Length, 2 mm.

Like *pulchra* but the whole thorax metallic green; the abdomen is only slightly so at (extreme) tip and somewhat distad of the middle there is a round dot near each lateral margin. Otherwise like the other two species. Fore wings very broad, pyriform, the apex subtruncate but not differing from the others.

From one specimen, enlarged as above.

♂: Not known.

Described from a single female captured with a female of *pulchra* by sweeping foliage and grass in a forest, September 3, 1912.

Habitat: Australia—Nelson (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen in xylol-balsam with a female of *pulchra* and one of *maculatipennis*.

This species when unmounted has the metallic green median line of the scutellum outlined as in the type species *magnifica* by that portion being shining and punctate while the rest of the scutellum is opaque and smooth or nearly.

2. **Achrysocharis maculatipennis** new species.

♀: Length, 1.20 mm.

Wholly metallic green and punctate including most of the abdomen; propodeum blue; legs white, the coxae darker; antennal dusky yellowish, the pedicel over twice the length of the first funicle joint which is subglobose; wings hyaline but in the fore wing there is a subelliptical stained area from the knob of the stigmal vein. Like the other species but with no yellow on the body and the abdomen is shorter, the wings less broad, more rounded at apex and moderately coarsely ciliated. The stigmal vein is longer. Posterior femur more or less dusky. Second funicle joint nearly twice the size of the first but still shorter than the pedicel which is long and obconic.

From one specimen, similarly magnified.

♂: Not known.

Described from one female captured with *grandis*.

Habitat: Australia—Nelson (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a slide with *grandis*.

TETRASTICHINAE

Neomphaloides Girault MS.

1. **Neomphaloides fusca** new species.

♀: Length, 1.30 mm.

Fuscous or brown including the legs, scape and pedicel, the rest of the antenna black. A row of dark spots down each side of the abdomen; scutellum with at least two grooved lines. Funicle joints cylindrical, subequal, thrice or more longer than wide, the pedicel only a little over half the length of either. Third club joint ending in a long spine. Wings narrow, hyaline, the marginal fringes moderately long. Intermediate ring-joint very short.

From one specimen, similarly magnified.

♂: Not known.

From one female captured while sweeping grass and foliage in the forest, September 3, 1912.

Habitat: Australia—Nelson (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, on a slide with the type of *Epichrysocharis fusca* Girault.

Tetrastichomorpha, new genus.

♀: Like *Tetrastichus* but the antennae with four short ring-joints, the club solid, the antennae 10-jointed. Fore wings with short marginal cilia. Propodeum with a median carina (no lateral) its sculpture rougher than that of the mesonotum which is as in the genus named. Pedicel much shorter than the funicle joints. Mandibles tridentate.

♂: Not known.

Type: *Tetrastichomorpha flava* n.sp.

1. **Tetrastichomorpha flava**, new species.

♀: Length, 2.20 mm.

Pale cadmium yellow, the abdomen lighter, lemon yellow, the legs and first two antennal joints concolorous with the abdomen. Wings hyaline. Flagellum and tip of valves of ovipositor black. Also on the abdomen along each side at margin a black longitudinal stripe extending from base to a little over a third toward apex; area containing ocelli dusky; extreme apex of each parapside black; also distal tarsal joint. Club terminating in a nipple and as long as the first funicle joint which is four or more times longer than broad.

From one specimen, similarly enlarged.

♂: Not known.

Described from a single female captured by sweeping foliage and grass in the forest, April 5, 1913.

Habitat: Australia—Nelson (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a slide with the type of *Arretoceroïdes feralis* Girault MS.

Tetrastichus

1. *Tetrastichus xanther* new species.

♀: Length, 2.00 mm.

Reddish yellow, immaculate but the abdomen crossed by six transverse black stripes, all complete; tip of ovipositor and center of face also black. Scutellum with four grooved lines, the propodeum with a short median carina flagellum dusky, the scape and pedicel concolorous. Funicle joints cylindrical ovate.

From one specimen, similarly magnified.

♂: Not known.

Described from a single female captured by sweeping foliage and grass in the forest, April 5, 1913.

Habitat: Australia—Nelson (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, on a slide.

OMPHALINI

Genus *Closterocerus* Westwood

1. *Closterocerus saintpierrei* new species.

♀: Length, 1.75 mm.

Brilliant metallic blue-green, the abdomen much darker, coppery but at base like the thorax. Tibiae and tarsi dusky pallid, the legs otherwise and the antennae black with metallic luster. Punctate-shagreened, the propodeum with a median carina. Fore wings bifasciate, the first fascia V-shaped, its apex distad and central; the fascia leaving at the apex of the marginal vein; the second fascia around the distal margin and rather narrow; also in the middle of the blade a blotch which projects into the angle formed by the two arms of the first fascia. Marginal fringes short. Antennae short, compressed fusiform, 8-jointed, the club 3-jointed, the small third joint terminating in a spur; pedicel longer than any following joints. Ring-joint apparently absent; it would make the eighth joint if present.

From one specimen, similarly enlarged.

♂: Not known.

Described from a single female captured by sweeping the edges of jungle near Nelson (Cairns) N. Q., April 5, 1913.

Habitat: Australia—Nelson, Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a slide.

This species is respectfully dedicated to the Abbe Saint-Pierre for his *The Project of Perpetual Peace*.

TETRASTICHINI

Trichaporoides Girault

1. *Trichaporoides viridithorax* new species.

♀: Length, 1.75 mm.

Bright metallic green, the abdomen very pale yellow with the center broadly blackish along the meson from apex to proximad a little more than half way to base, this coloration verging to metallic green at apex; a line of blackish around base and down each side (dorsal aspect) for a quarter the length of the abdomen; at center of base this is accented by a triangular projection; also these side lines joined by transverse rather faint cross lines. Lower half of face yellowish. Wings hyaline. Posterior coxa like the thorax, all of the legs otherwise pale lemon yellow except the distal tarsal joints which are black. Antennae dusky, the first funicle joint as long as the club, the pedicel as long as the third funicle joint. Scutellum with four grooved lines. Distal club joint distinctly the longer.

From one specimen, similarly enlarged.

♂: Unknown.

Described from a single female captured by sweeping.

Habitat: Australia—Nelson (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a slide (with the type of *Closterocerus saintpierrei* Girault.)

PODAGRIONINAE

Pachytomoidella new genus.

♀: Like *Pocagrionella* but the club enlarged and the four distal funicle joints transverse.

♂: Not known.

Type: *Pachytomoidella magniclavus* n.sp.

1. *Pachytomoidella magniclavus* new species.

♀: Length, 3.00 mm., exclusive of ovipositor which is not quite as long as the body.

Metallic acneous green, the venter of abdomen, the tibiae, the scape, pedicel and funicle, brown; club and valves of ovipositor black. Wings hyaline, the postmarginal being short but nearly twice longer than the stigmal. Posterior femora beneath with seven large teeth. Polygonally sculptured. Median carina of metathorax and propodeum divided just out from origin, then diverging. Scutum rougher, punctured. Antennae

11-jointed, the club large and ovate as in *Polynema*, as long as the funicle whose first joint is longest, subquadrate, the distal four funicle joints more than twice wider than long.

From one specimen, similarly magnified.

♂: Unknown.

Described from a single female captured by sweeping the edge of jungle near Nelson (Cairns), N. Q., April 5, 1913 (A. P. Dodd).

Habitat: Australia—Nelson, Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a tag.

EULOPHIDAE—ENTEDONINI

Mestocharella new genus

♀: Agreeing with *Mestocharis* Foerster but the antennae with four funicle joints, two club joints the distal one terminating in a little spur; 9-jointed, the ring-joint simple. Scutellum with two grooved lines. Abdominal petiole distinct but short, propodeum plus metathorax with a median carina and a number of other irregular carinae. Stigmal vein very short, the postmarginal still shorter. Small, slender Mandibles tridentate, the third tooth truncate. Pronotum long.

♂: Not known.

Type: *Mestocharella feralis* n.sp.

1. *Mestocharella feralis* new species.

♀: Length, 1.20 mm.

Very dark metallic with a purplish cast, the venter of the abdomen and a large ovate area in the center of proximal half of its dorsum, yellow; wings hyaline; legs brownish yellow, except the concolorous coxae; antennae concolorous with legs except distal three joints which are blackish. Wings ample. Thorax with a scaly sculpture, rather coarse. First funicle joint longest, all longer than wide and cylindrical but the fourth ovate, longer than either of the two club joints.

From one specimen, similarly magnified.

Described from one female captured by Mr. Alan P. Dodd by sweeping in a patch of jungle near Nelson (Cairns), N. Q., April 4, 1913.

Habitat: Australia—Nelson, Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a tag, the head on a slide.

Chrysoatomus Ashmead

1. *Chrysoatomus latipennis* new species.

♀: Length, 1.45 mm.

Dark metallic blue, the legs yellow except the coxae, the cephalic femur more or less fuscous; scape yellowish, the flagellum black brown. Wings

uniformly, lightly but distinctly, stained, the stigmal and postmarginal veins very short; marginal fringes short, the fore wings broad. Antennae 8-jointed with a ring-joint, the club 3-jointed, the two funicle joints cylindrical, tapering distad, subequal and longest except the scape; third club joint with a spur. Scutellum without grooves, the propodeum with a median carina. Polygonally reticulated. Mesoscutum *apparently* trilobed. Antennae filiform.

From one specimen, similarly magnified.

♂: Not known.

Described from a single female captured by sweeping low vegetation along a brooklet, mountain side (500 feet), jungle growth, October 28, 1911.

Habitat: Australia—Babinda, Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a slide (with the head of type *Mestocharella feralis*. Gir.).

This species is probably a new genus but I failed to determine with certainty the division of the mesoscutum so decided not to describe it.

TETRASTICHINI

Genus *Tetrastichus* Haliday

1. *Tetrastichus saintpierrei* new species.

♀: Length, 1.85 mm.

Brilliant metallic grass green with the usual sculpture; legs white except the concolorous posterior coxae. Wings hyaline. Abdomen, dorsal aspect, with imperial purple, its proximal third orange yellow, the metallic-coloration projecting a little cephalad at each lateral margin. Antennae with two ring-joints; first funicle joint longer than the others.

From one specimen, similarly magnified.

♂: Not known.

From a single female reared with other eulophids from an oval gall on twigs of *Melaleuca* (Cecidomyiid galls), April 2, 1913 (A. P. Dodd).

Habitat: Australia—Nelson (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a tag.

Respectfully dedicated to the Abbe Saint-Pierre for his *The Project of Perpetual Peace*.

APHELININI

Genus *Aphelinus* Dalman.1. *Aphelinus dies* new species.

♀: Length, 1.30 mm.

Black, the antennae and legs lemon yellow (except posterior coxae, the intermediate coxae a little dusky); wings hyaline; abdomen lemon yellow crossed by obscure dusky stripes; discal cilia proximad of oblique hairless line consisting of two long lines and a third short (two or three cilia) one, the cilia in these lines coarse, six or seven times coarser than the main cilia in the outer portion of the blade. Venation pale yellow.

From one specimen, similarly enlarged.

♂: Not known.

Described from a single female captured by sweeping, Nelson (Cairns), N. Q. March.

Habitat: Australia—Nelson, Queensland.

Type: In the Queensland Museum, Brisbane, the foregoing specimen in balsam.

Epiperilampus Girault.1. *Epiperilampus channingi* new species.

♀: Length, 2.10 mm.

The same as the type species (*xanthocephalus* Girault) but the parapsides concolorous and the stigmal vein is shorter, distinctly shorter than the marginal, the two subequal in the type species. Also the antennae are lighter. Otherwise, I cannot distinguish between them.

From one specimen, similarly magnified.

♂: Not known.

From one female captured by sweeping grass in forest, September 13, 1912. Respectfully dedicated to William Ellery Channing in recognition of his public utterances against war.

Habitat: Australia—Quingilli (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a tag (type subsequently lost accidentally).

Genus *Aprostocetus* Westwood1. *Tetrastichus* (*Aprostocetus*) *kurandensis* (Girault).

I have verified the one ring-joint in the antennae of this species, also its description; the femora are slightly suffused with the metallic coloration of the body. The species closely resembles the following species with which I have closely compared it. In both species the second abdominal segment is polygonally reticu-

lated (only seen in certain lights); also both species are parasitic upon braconids.

Genus **Tetrastichus** Haliday

1. **Tetrastichus laddi** new species.

♀: Length, 2.50 mm.

Like the preceding species but the femora and pedicel concolorous, the distal funicle joint shorter.

From many specimens, similarly magnified.

♂: Length 2.00 mm.

The same as the male of the preceding species but with the differences noted for the female.

From many specimens, similarly magnified.

Described from many specimens of both sexes reared from what appeared to be *Apanteles* cocoons taken from foliage of *Careya australis* in the forest, Nelson (Cairns), N. Q., A. P. Dodd. (April 5, 1913).

Habitat: Australia—Nelson, Queensland.

Types: In the Queensland Museum, Brisbane, one specimen of each sex on a tag.

Respectfully dedicated to William Ladd.

Neotetrastichodes, new genus

♀: Like *Tetrastichodes* Ashmead but the antennae with four ring-joints and the funicle of male antennae with long hairs; like *Quadrastichodes* but the funicle only 3-jointed. Male antennae with funicle 4-jointed, the club 3-jointed, the first funicle joint shorter than the pedicel. Ring-joints extremely short. Mandibles tridentate.

Type: *Neotetrastichodes flavus* n.sp.

1. **Neotetrastichodes flavus** new species.

♀: Length, 1.85 mm.

Light orange yellow, the wings hyaline, the legs and scape concolorous with the body; middle of face dusky, also dorsum of abdomen obscurely. Flagellum dusky yellow. Funicle joints subequal, each slightly shorter than the pedicel; a spur ends the third club joint which is shortest.

From one specimen, similarly magnified.

♂: Length, 1.30 mm.

The same but the cephalic part of the thorax is dusky and the abdomen wholly so excepting for a large whitish area centrally near base. Last funicle joint longest.

From one specimen, same magnification.

Described from a single pair captured by sweeping grass in a forest at Nelson (Cairns), N. Q., April 30, 1912.

Habitat: Australia—Nelson, Queensland.

Types: In the Queensland Museum, Brisbane, the above specimens together on a slide.

Trichaporoides Girault.

1. **Trichoparoides flavus** new species.

♀: Length, 2 mm.

Differs from *fasciiventris* in having four abdominal stripes, in lacking the metallic coloration, in having the pedicel shorter, plainly shorter than the distal funicle joint, in having the ovipositor plainly but shortly projected and in being brownish yellow, the thorax obscurely dusky, more especially at cephalic margin of scutum centrally; antennae dusky.

From one specimen, similarly magnified.

♂: Not known.

Described from a single female captured at Babinda, Q., October 28, 1911 by sweeping foliage below a clearing at foot of mountain (jungle).

Habitat: Australia—Babinda, Queensland.

Type: In the Queensland, Museum, Brisbane, the above female on a slide.

Epitetrastichus new genus.

Type: *Epitetrastichus speciosissimus* n.sp.

1. **Epitetrastichus speciosissimus** new species.

♀: Length, 1.90 mm. Robust.

Golden yellow, characteristically marked with black as follows: The scutum with a large obconical black area from cephalic margin to proximal third of scutellum where its obtuse apex ends, the marking leaving the lateral margins of the scutum broadly yellow; most of interior of each axilla, a triangular spot at cephalo-mesal margin of each parapside, the pronotum laterally, the metathorax and propodeum, much of mesopleurum and sides of propodeum, distal two tarsal joints and six broad stripes across the abdomen, each with a large, roundish yellow spot centrally on each side, forming a longitudinal line of large spots down each side of the abdomen (from the third segment, the first cross band of black being narrow or rather the spots confluent), those of the fifth stripe most clearly delimited, largest and quadrate; in the sixth stripe, the spot is small and joined laterally to the yellow of the body; tip of abdomen black; also upper half of occiput, center of vertex nearly to eyes and less so, the scrobicular cavity. Legs concolorous with general body color. Antennae dusky yellow. Median groove of scutum fine. Wings hyaline, the stigmal vein long. First funicle joint longer than the pedicel, the third shorter than it.

From one specimen, similarly magnified.

♂: Not known.

Described from a single female captured by sweeping grass bordering on a cane field, October 29, 1911. Jungle country.

Habitat: Australia—Babinda, Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a slide.

This remarkable species, both in appearance (color pattern) and in the fact that the antennae bear five ring-joints, is otherwise like *Tetrastichus* Haliday. The ring-joints are extremely short like lamellae.

PEDIOBIINI

Epacrias new genus.

♀: Agreeing with *Paracrias* Ashmead but the antennae with two ring-joints, the club 3-jointed, the funicle 2-jointed, the third club joint terminating in a spur. Propodeum smooth, tricarinate; scutellum without grooves. Second abdominal segment not very long.

♂: Not known.

Type: *Epacrias nigriviridis* n.sp.

1. *Epacrias nigriviridis* new species.

♀: Length, 2.30 mm.

Blackish metallic green, rather coarsely regulose. Legs and antennae concolorous, the proximal three tarsal joints whitish. Wings hyaline, the postmarginal vein much shorter than the very short stigmal. First funicle joint longest. Petiole stout, distinctly longer than wide.

From one specimen, similarly magnified.

♂: Not known.

Described from one female captured by sweeping in a forest, September 13, 1912.

Habitat: Australia—Quingilli (Cairns District), Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a slide.

ECTROMINI

Calocerinella new genus.

♀: Agreeing with *Calcocerinus* Howard but the marginal vein extraordinarily lengthened, over twice the length of the submarginal; lateral ocelli nearer the cephalic one than to the eyes; axillae meeting; face convex, the antennae inserted near the mouth border, 12-jointed with one very short ring-joint, the club 3-jointed, the funicle joints very long, the first over twice the length of the pedicel. Mandibles with two nearly equal teeth. Propodeum with a median carina. Fore wings with a short, oblique, hairless line from the stigmal vein, more or less parallel with the

cephalic margin; wings trifasciate. Stigmal longer than the posmarginal, both short. Abdomen shorter than the thorax, compressed, pointed at apex, the wings extending beyond it for some distance. Legs long.

♂: Not known.

Type: *Calocerinella trifasciatus* n.sp.

1. *Calocerinella trifasciatus* new species.

♀: Length, 1.90 mm.

Very dark metallic purplish, the legs concolorous, the proximal four tarsal joints and cephalic femora and tibiae dusky yellowish, also the head and first two antennal joints. Finely alutaceous, the scutum also with fine thimble punctures. Club joints short, the club itself not as long as the first funicle joint but a third longer than the sixth which is only half the length of the first. Third band of fore wing much the longest, covering all of over the distal third of the blade except around apical margin which is clear; middle band with its distal margin crossing the apex of the stigmal vein.

From one specimen, same magnification.

♂: Unknown.

From one female captured by sweeping in the forest, April 9, 1913.

Habitat: Australia—Nelson (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a tag, the head on a slide.

ELACHERTINI

Zagrammosoma Ashmead

1. *Zagrammosoma pulchra* new species.

♀: Length, 1 mm.

Thorax dark metallic green, wholly subrugoso-punctate, the head pale yellow, the ocellar area darker, the face with a line running down it from about the level of the antennae (between them and the ends of the eyes), the line long, wavy, metallic green, not touching the clypens but extending to the end of the head; also a short, broad metallic line from latero-ventral margin of eye to end of head. Wings hyaline excepting a fuscous line down the length of the stigmal vein. Legs pale yellow (also the scape) but the posterior femur with a broad black band around the middle and a narrower one just below the knees on the tibiae. Abdomen dusky black marked with pale yellow as follows: One round spot on each side just out from base, followed by a subresentic transverse band, on the next segment followed by an irregular large marking on each side whose caudal margin is deeply emarginate, followed on the next segment (the third, the second long) by a still wider, somewhat similar marking, and in the next segment a subobconical spot near lateral margin and on the next a similar but larger, subquadrate spot, obscure. Antennae 8-jointed, the ring-joint ap-

parently present but very small (it is counted here); funicle subcompressed, 2-jointed, the first joint largest, subglobose; distal or third club joint terminating in a little spine. Head triangular, hardly longer than wide. Propodeum tricarinate. Mandibles 5-dentate.

From one specimen, similarly magnified.

♂: Unknown.

From one female captured by sweeping in a forest, April 9, 1913.

Habitat: Australia—Nelson (Cairns), Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a slide.

Zagrammosomoides Girault = *Tetrastichus* Haliday.

Zagrammosomoides fasciatus new genus and species (April, 1913), being described in the Entomologist of London, I find subsequently is *Tetrastichus*, the mistake being due to the fact that the submarginal vein was first thought to be unbroken. Therefore, *Tetrastichus fasciatus* Girault MS. from Australia is preoccupied and I propose the new name *fasciatella* for it.

NELSON (CAIRNS), N.Q.,

Australia.

April, 1913

A THIRD ADDITION TO THE MYMARIDAE OF AUSTRALIA

BY A. A. GIRAULT

All of the following Chalcidoid *Hymenoptera* belonging to the family *Mymaridae* have just recently been captured in North Queensland. Two notes on European species are added.

Genus *Polynema* Haliday.

1. *Polynema australiense* new species.

♀: Length, 1 mm.

Like *Polynema spenceri* Girault but the joints of the antennal funicle are longer; the first joint is distinctly shorter than the third, about equal in *spenceri*; the second joint is six or more times longer than wide but in *spenceri* only about four times; the distal two joints are subequal, joint 4 distinctly longer than either. While in *spenceri*, the distal three joints of the funicle are subequal. Otherwise the same; the pedicel and first funicle joint pale yellowish, the scape black.

From one specimen, $\frac{2}{3}$ -inch objective, 1-inch optic, Bausch and Lomb.

♂: Not known.

Described from a single female captured by sweeping grass and foliage in a forest along Cape River, Capeville (Pentland), Queensland, December 26, 1912.

Habitat: Australia—Pentland, Queensland.

Type: In the Queensland Museum, Brisbane, the above specimen on a slide (mounted with the type of *Gonatocerus dies*).

2. *Polynema pax* new species.

♀: Length, 1.25 mm.

Jet black, the legs and petiole dusky brown, the tarsi lemon yellow; wings hyaline; scape, pedicel and first funicle joint lemon yellow, the distal three antennal joints black, funicle joints 2-4 dusky yellowish. Scape without sculpture. Near to *spenceri* but the second funicle joint plainly over twice the length of the pedicel and the discal ciliation of the fore wing does not disappear proximad; the color differences are also noticeable.

From one specimen, similarly magnified.

♂: Not known.

From a single female captured with *Gonatocerus saintpierrei*.
A jungle species.

Habitat: Australia—Kuranda, Queensland.

Type: In the Queensland Museum with that of *Gonatocerus saintpierrei* Girault.

Genus *Gonatocerus* Nees.

1. *Gonatocerus dies* new species.

♀: Length, 1.05 mm.

Jet black. Face, parts of scutum and knees obscure golden yellow. Wings hyaline. Base of abdomen more or less obscurely yellowish; also the scape up each side. Belongs to the group of broad-winged species and is nearest to *helmholtzii* and the following species but the wings are noticeably less densely ciliate, the ciliation coarser and the ovipositor is plainly exerted for a length equal to a fourth that of the abdomen, the latter as in the North American *rivalis*. Marginal cilia of fore wing short, the marginal vein short.

From one specimen, the same magnification.

♂: Not known.

Described from a single female captured with *Polynema australiense* described above.

Habitat: Australia—Capeville (Pentland), Queensland.

Type: The above specimen mounted with the type female of *Polynema australiense*. •

2. *Gonatocerus saintpierrei* new species.

♂: Length, 1.80 mm. Very large for the family.

Jet black, the abdomen suffused with brownish; legs reddish brown, the coxae and posterior tibiae darker, the tarsi lighter; scape and pedicel reddish brown to orange, the remainder of antenna black. Fore wings with a midlongitudinal, subcylindrical fuscous stripe extending from near apex proximad a little more than half way to the marginal vein, the latter very long. Marginal cilia of fore wing short, the longest not more than between a sixth and seventh of the greatest wing width, across the latter about thirty-five lines of moderately coarse discal ciliation. Fore wings about as broad as those of the Hawaiian *Polynema rubriventris* and of *Gonatocerus spinozai* of Australia. Much larger than *Gonatocerus ater* Foerster.

From one specimen, similarly magnified.

♀: Not known.

Described from one male captured (Alan P. Dodd) by sweeping foliage and grass along the edge of a jungle at Kuranda, N. Q., 18 December, 1912. The abdomen is subpetiolate.

Habitat: Australia—Kuranda, Queensland.

Type: In the Queensland Museum, Brisbane, the foregoing specimen on a slide (mounted with a *Polynema*).

Respectfully dedicated to the Abbé Saint Pierre for his work entitled *The Project of Perpetual Peace*.

Cosmocomoidea Howard.

1. *Cosmocomoidea renani* Girault.

The male of this species has recently been captured and it is described herewith. Like the female but the antennae 13-jointed, filiform, the pedicel very short, the first funicle joint and club subequal, shortest of the flagellum yet the club a little longer, nearly equal to the distal four funicle joints; funicle 2 longest, 3, 4, 5 and 6 each slightly shortening, 2 about six or more times longer than wide; funicle 1 thrice the length of the pedicel; tarsi 5-jointed.

This male was captured at Nelson (Cairns), North Queensland, Australia, by sweeping in forest, April 1, 1913 (A. P. Dodd).

Genus *Anagrus* Haliday.

1. *Anagrus hydrophilus* Ashmead.

I have seen the type of this species in the United States National Museum. Only the hind tarsus remained, showing four joints. Labelled "*Anagrus hydrophilus* Ashm., ♀, 32. Ein süsswassersee in dem Mündungen von Syr-darja. Turkestan, 1901, d. Berg;" "Syr. Darja. Rus. Turkestan, L. Berg, Collector." One tag.

Genus *Polynema* Haliday.

1. *Polynema bergi* Ashmead.

The type of this species in the same collection and in the same condition, the single remaining leg portion showing apparently 5-jointed tarsi. The single tag bore the same label.

NELSON (CAIRNS), N. Q.

Australia.

April, 1913

NOTES ON LAKE MICHIGAN SWARMS OF CHIRONOMIDS; QUANTITATIVE NOTES ON SPRING INSECTS¹

BY ALFRED C. BURRILL

Ever since Frederick Knab's paper on the "Swarming of *Culex pipiens*" in *Psyche*, October, 1906, the writer has wished to see such swarms. Field trips seem to have lacked opportunity for such interesting observations until, in 1910, the summer was spent at a bungalow on the Lake Michigan bluff at Whitefish Bay, near Milwaukee, Wisconsin, at an altitude of 150 feet above the beach. An ample porch screened in on three sides of the house furnished an excellent collecting ground for all small flies which sought to rest over night and had not discovered or else did not prefer to seek the maple trees back (west) of the house. The flies were blown in from the lake (east of house) and the porch screen was generally the first alighting place above the bluff bank. Observations morning and evening during the spring and early summer showed this location to be very favorable for observing the habits of several species of small midges. Collections were made almost daily and deposited with the Milwaukee Public Museum where most of the 2300 specimens await identification.

MIDGE WEATHER

My first record was on May 19 when a mangled mass of dozens of black Chironomids was found washed down by the rains from an orb spider web. These midges were still alive 24 hours after the rain, and probably 48 hours from the time they had become entangled. Of the many spider webs about the eaves and the porch screens, all were filled with Chironomids or were replenished nightly during the two previous weeks of dry weather. It is a

¹ Digest of the object, location, and methods of collection was reported at the April 4, 1912 meeting of the Wis. Acad. of Sci. Arts and Letters, but the paper was unfinished at the time their annual volume went to press.

fair inference, then, that midges began to emerge before May 5 in this cold, lake-governed latitude. May 21 to 23 was a period of rainy and foggy weather when none of these insects were in evidence, there being three such periods in May alone.

Weather quickly affects the swarms, as this storm shows, and so does cold alone, say below 65° F. On the very cold afternoon of May 25, the midge swarms were nearly discontinued. Few flies were in the air at sunset, but hundreds of them were perched on the porch screens, seven pairs of copulating Chironomids being taken there. May 26 the weather was unfavorable and on the morning of May 27 I noted the midges resting mostly on the porch screen though a few tried flight close in the lee of it. During this period only two or three each of mosquitoes, Pimplinae, and Stoneflies, could be found, so the midges easily out-numbered other species. Even so, the coming of warmer weather by the evening of the 27th coaxed out a larger variety of midges than ever. Likewise, certain spotted-winged Tipulids, always few compared with midges, were noted in larger numbers than ever after the storms of May 23 and 27.

May 29, a high wind which continued on the 30th; interfered with flying, so that delicate midges could not keep to their wings, while the cold temperature probably inhibited flight. The cold spell culminated on the 2d of June in a storm at a temperature of 36° F. that nothing but a Tabanid (*T. lasiophthalmus*) could withstand. The morning of June 3 was much warmer and seven supposedly different species of Chironomids were captured on the porch screen. These insects were very few in numbers during the continued cold to the evening of June 5, when a few more midges appeared, and the next evening, June 6, there seemed to be more midge flies on the porch screen than on any previous night.

Dr. Asa Fitch records a New York forest swarm of *C. nivoriundus* as early as April 27, 1846 (1847, May. Winter Insects of Eastern New York. Am. Jour. Agri. Sci. V. 272-284). Kirby and Spence say (1858, An Introd. to Ent. 7th ed., p. 60), when speaking of both the mosquitoes and the midges, the "*Tipulariae* of Latreille seem endowed with the privilege of resisting any degree of cold, and of bearing any degree of heat. In Lapland their numbers are so prodigious as to be compared to a flight of

snow, when the flakes fall thickest, or to the dust of the earth." As to the vitality of the midge, even the cyanide bottle may take five minutes to kill them. Its vitality is also shown by the fact, as noted before that some of the midges remain alive and moving two days after being caught in a spider web washed down by rain, without reckoning how long previous to the rain the flies had been snared in the web. Morley² quotes English writers in "Country Side" as observing swarms of midges or mosquitoes, May 31, 1909; a hot June 28 (Gilbert White); a hot July 12, 1912; a hot day in August, 1909; and a cool twilight, 55° F., August 7, 1912. This shows that midges attract attention at similar times and temperatures in the British Isles. The quoted 55° F. indicates that, later in the season, midges fly at lower temperatures. Humidity may prove to be more of a controlling factor than ordinary temperatures, since the females require to lay their eggs near water. In the above case, Morley says it was a damp evening.

SPECIES OF MIDGES AND CONTEMPORARY INSECTS

Regretting my lack of taxonomic training, I withheld these notes for three years, hoping that the Museum could get the specimens determined, but no opportunity has as yet offered. The following notes, however, should be of sufficient interest biologically to warrant releasing them for the printer.

One Nile green male Chironomid with dark tipped abdomen was seen on May 20, but other than this, only black species had been previously seen. On May 24, two smaller species were noted, the larger of the two being greenish; also a Stratiomyid (*Allognosta* sp.), but the majority of the individuals were still this early black species.

The evening of May 27, following the cold spell of May 25 to 27, the catch of a larger variety of Chironomids included four large midges of a very delicate white or straw-color and two small ones of the same color, two other small straw-colored ones with a banded appearance, four small ones of a light brown color, and five of a light green color, besides 16 of the black ones to be discussed as the commonest of all. These numbers show the approxi-

² The Cause of "Humming in the Air," by Claude Morley. Ent. Mo. Mag., Nov., 1912.

mate proportions of the kinds of midges about the porch. When midges were not flying, all species were captured with equal ease by placing small cyanide bottles used in relays, over the flies as they rested on the screens. This method avoided all handling of the delicate forms, on whose frail legs the tarsi are a most important feature in identification. Catching in nets is not advised, since enough specimens can be caught by the more careful method using vials. Thus six or ten midges can be successively captured in a vial before there is much danger of one of them trying to escape from the tube. The increase in midges noted above was accompanied by other forms, as Tipulids, a large yellow-brown Ophion, Curculionids, Coccinellids and Cerambycids, a Sepsid, and a Scatophagid, May 27 to 28.

On May 28 other less common midge species resting or flying included a whitish winged black form, two different species of tinier black midges, the greenish or straw-white species of larger size than the common black one, and a very few Tipulids and Culicids. Two clear winged Tipulids were also taken, four Psychodids, a Trichopterid and a Meloid beetle.

During the close of the cold spell, May 29 to June 5, a Bibio, two species of Tipulids, two Staphylinids, two Cerambycids, a Carabid and a Chrysomelid appeared, besides Myriapod forms. With the warmer weather on the evening of the 6th and morning of the 7th, the beginning of midge convention week, one might say—there were captured specimens of black Chironomids of the various species collected before. One brown species was taken with a red mite on the right mesothorax, and one green midge with a mite elsewhere on the body. Twenty-two greenish-brown, quite small midges of a distinct species were taken and tinier ones of many different species, if one may judge by the variety of colors and forms. These figures indicate that June 7 marked a new period in the emergence of insects generally since nearly twice as many kinds of midges were noted as during the previous month and also more mosquitoes, new Tipulids, a leaf hopper, a Hemerobiid, a stone fly, and an Ichneumonid. Thus three cyclonic storm periods were successively followed by a greater variety and abundance of midge and other insect species. In the very backward spring of 1912, I duplicated these observations near Lake Mendota, Madison, Wis. The first swarm of midges

was seen towards evening over the University cane fruit garden, May 29, and again May 30. A rainy day and later a hard cold north wind inhibited much swarming from May 31 to June 4, tho thousands of these flies clung to the under side of leaves of bushes and trees, or in the grass, where also thousands of stone flies were keeping close to cover at 2 p.m. On June 4, there were great swarms flying, but a cold spell, June 5 to 6, checked them. June 7, 1912, still bigger swarms were seen, the temperature moderating slowly.

CHANGE IN PREDOMINANT MIDGE SPECIES

Though desultory collections were made, observations were not continued in earnest until June 12, despite that midges were present in the interim from June 7. On the 12th about ten kinds of midges were taken, and a few of the rarer forms on June 14, 15 and 16. The lists of other sorts of insects increased greatly in this week and are therefore omitted, though the specimens are accessible at the Public Museum, Milwaukee, Wis.

A trap lantern was arranged on the 17th, 18th and 19th with little success, only four of each of two common kinds of midges being taken. On the 20th there was less success but on the 21st I turned the trap directly towards the lake and secured three or four dozen Chironomids. Scattering collections were made on the 22d but on the 23d, midges were in still greater abundance. On the 29th and 30th, trap collecting was again good. July 1, the little black midge so common in the first month of collecting, had nearly disappeared from the swarms of the last three days, and was replaced by a black species with a shiny thorax, as the predominant type.

SWARMING AND MATING

On May 24 at 6 a.m., following the storm of the 23d, the process of mating was observed among several couples, tail to tail, the claspers of the slim male abdomen grasping tightly the stouter tipped female abdomen, pairs noted May 25, as also in copula, suggest the period of fertility.

In the evening of May 24, considerable time was spent watching the increased swarms of the common early black midge noted

before now forming a nearly spherical cloud, now stretching out cigar-shaped, now rising and falling near the earth, the swarms keeping close to the house on the lake side (east), a distance of about four rods from the edge of the 150 foot bluff. As noticed at various points along Day Avenue on the way from the street car to the bungalow, there were several such swarms composed of fewer individuals. From these swarms fell mating pairs and dozens of such pairs were rolling about on the ground. Females seemed to fly into the swarms of males, and pairs then fell out of the swarm as if unable to maintain their position in the air. Generally these pairs would not separate very quickly. For example, two larger flies, a Stratiomyid (probably *Sargus decorus*) I had just rescued from a tub of rain water, and a Bibionid (*B. albipennis*) from a window screen, were placed in a roomy vial with a pair of these mating Chironomids, and there the two bigger flies tumbled over the mating pair several times and knocked them about before the midges became separated.

POSITION OF DANCE INCONSTANT

The evening and morning midge dances did not occur in exactly the same places as noted during four days, May 24 to 28. While other species of midges occasionally enter the swarms, the little, long, black midge already discussed remained predominant and controlled the position of the swarm except when momentary gusts of wind blew the whole mass out of place. A few evenings previous the larger swarm was just east of and a little lower than the gable end of the ridge pole and bulged lakewards with every slight draft of the westerly intermittent wind. Two nights later a swarm hovered about six feet lower than the previous position a point at the upper sash of the first story window and about a yard from it. On the morning of the 28th the chief swarm was above the porch roof and south-east of the house, a position about a rod from the window position last noted, but not above any prominent part of the house nor above any part different in color. These locations do not well coincide with the recently advanced theory (Radl. 1903, Untersuchungen über den Phototropismus der Tiere., pp. 80-1 in contrast with p. 126), that the species avoid the direct rays of the sun, choosing the shady side

of objects away from the setting sun. We disagree in the fact that the early morning still found the swarms on the east side of the house without protection from the rays of the rising sun.

* Radl stated in 1901 (*Untersuchungen über die Lichtreactionen der Arthropoden*. Archiv f. d. ges. Physiol. Bd. 87 p. 429 Bonn): "One cannot suppose that the midges seek the direct sunbeams or again the shadows, rather do they hover and swarm just as much in direct sunlight as in shady places. Yet I find that they so orient themselves in most cases that the object towards which they are oriented, lies between the swarm and the sun, though indeed, not in the plane of the object but usually somewhat above or below" [its apex]. His word "midges" is more in the sense of gnat to include Culicids, and his observations do not seem to distinguish Chironomids sharply.

At the time of my above observation, May 27, another swarm had a position a rod east of the house in the open lot towards the lake bluff and apparently without orientation to the dead young tree, eight feet high, which stood nearby. I would not mention facts of such apparent unimportance but that Radl (1901, *Über den Phototropismus einiger Arthropoden*. Biol. Centralbl. Bd. 21, pp. 75-86; 85-6 Leipzig. *Untersuchungen über die Lichtreactionen der Arthropoden*, Archiv f. d. ges. Physiol. Bd. 87 pp. 418-466; 429-432. Bonn) claims the midges orient to particular objects, "trees, bushes, sign-posts, or even heads of grass, grey stones, foot-paths or white paper," and the nearest prominent object was this dead tree, although the midges were not very close to it. Whether this same swarm was, on the morning of the 28th, the one found north of the house about a rod—that is, three rods from the dead tree, I cannot say, for it may have been a different swarm. However, the swarm near the tree was missing the morning of the 28th, so that it is supposed some of its individuals, if they were actuated to further dancing, would move to these other positions.

Dr. Wheeler (1899, February 22, *Anemotropism and Other Tropisms in Insects*, Archiv für Entwicklungsmechanik der Organismen, Bd. 8 pp. 373-381 Leipzig) speaks of a swarm of *Hilara* sp. noted over a fixed spot daily for two weeks, saying (p. 375): "It is difficult to account for this persistence in one particular spot unless it be due to some odor emanating from the soil and

attracting and arresting the flies as they emerge from their pupae." Why could it not be due to radiation or warm air currents, as he notes that "the tiny flies orient themselves to every passing breeze"? He says (ib., p. 377), "Even if the insect be strongly heliotropic, as is the case in most Diptera, it orients itself to the wind or to gravity (in another genus noted) no matter whence the light may fall." It is evident that some other explanation is still to be sought; to Wheeler's odor emanation, I will add radiation of ground electricity, of heat or, better, of warm air currents, which, if there be any wind or general atmospheric drift, could not rise vertically and would then arise diagonally as Radl seems to find this diagonal position to be true of swarms which he cites as exceptions to his light theory; thus ("Untersuchungen," etc. Archiv, etc., p. 433).

"Einige Erscheinungen bleiben mir an den Schwärmen unerklärt. Erstens habe ich in einigen Fällen nicht angeben können, wogegen die Mücken eigentlich orientirt wurden, wenn ich nicht an Wirkungen der über 100 Schritte entfernten Bäume oder an ganz kleine Unregelmässigkeiten der Erdoberfläche denken wollte. Ferner habe ich gefunden, dass der verticale Durchmesser der Schwärme fast immer grösser ist als die horizontalen; derselbe pflegt auch nicht senkrecht zu sein, sondern etwas geneigt, so dass das obere Ende des Mückenschwarmes mehr seitlich von dem Gegenstande, gegen welchen derselbe orientirt ist, schwebt als das untere. Auch ist mir nicht klar, wie die Lichtverhältnisse an der Oberfläche des Wassers das Schwärmen namentlich der Phryganiden bedingen können. Dass alle hierher gehörigen Erscheinungen sich nicht gleich klar durchsehen lassen, kann nicht überraschen, da wir nichts als die grössten Bedingungen des Schwärmens kennen."

I am indebted to my colleague, Professor J. G. Sanders, for the original suggestion of ascending air currents in connection with a discussion of the factors which could control the position of a columnar swarm such as occasionally occurs among the *Chironomus plumosus* midges. I do not mean, however, to limit the flies to any one of these forces, but rather to suggest that their movements are explained by a resolution of two or more of these forces.

It should be a fairly easy matter for proof by operating an

electric fan outdoors so as to make a gentle air current, and with an electric heater warmer air could be manufactured and by boiling water on same, increased humidity could be provided. In the absence of experimental proof, I wish to refer to Radl's notes above quoted that midges orient even to "grey stones, foot-paths, or white paper," and compare my later data.

May 29, 1912, north of the University Dairy building, midge swarms occurred in the flat below the hill on which the Dairy stands and below the tops of the trees bordering Lake Mendota, to the north of the flat. The midges of a medium-sized species appeared to be oriented to no trees, and hovered above cane fruits, but not oriented to any particular clump of canes or fence posts supporting the canes. Not 50 per cent of the midges stayed oriented to the light wind which was variable. This swarm showed more irregularity than others noted.

On June 3, the afternoon north wind abated so that by 7 p.m., a swarm of tiny midges were flying above the Lower Campus. Although this is bare ground (used for baseball) no particular point on the ground seemed distinguishable. Professor Sanders and I walked through the swarm once or twice and waved at it without any reaction as definite as described by Schuster (1904, November. *Massenschwarm der Federmücke Chironomus plumosus*). *Der Zool. Garten*, v. 45, no. 11, pp. 344-5) and quoted in my previous paper on *C. plumosus* (*Bull. Wis. Nat. Hist. Soc.*, v. 10, nos. 3-4 December, 1912, p. 131) as bouncing instantly upward out of reach. In Morley's paper (*l. c.*), few of the dozen observers there noted paid attention to swarm location, save that one was over Ascot Heath, some other swarms were flying over a moat, and that others were disturbed by a slightly gusty southwest wind so that when the companies of dancing insects were struck, "they descended and always rose to the height of invisibility during the frequent lulls."

To match Radl's case of a footpath, I give my notes of June 4, 1912. About 7 p.m., thousands of a small midge (nearly all 1912 notes are supplemented by specimens deposited at the State Entomologist's office) were swarming along the cement sidewalk leading up the south slope to Agricultural Hall, Wisconsin University. This great swarm followed the exact curve of the cement walk continuously for a hundred paces or 18 rods, and was pecu-

liar in that it did not hover over the walk but over the south grass edge of the walk. Still more remarkable was the position the swarm took—quite nearly vertical in a peculiar wall-like formation out over the grass edge. At times they arose in the air about twelve feet or three and a half meters, but usually remained at a four to eight-foot level, or about two meters. Few midges came within a foot of the ground. There were thicker nuclei here and there as if these smaller swarms had formed the living wall. For some acres about, I could find no other swarms on other walks or over the lawn except two small ones near the walk on Linden Drive and about seventy-five paces from the main swarm. A sweep of the net gave only males. Frequently a midge left the swarm, soaring higher southward until he came to rest in the linden trees. No regular motion of the swarm could be unravelled though most of the midges were oriented to a slight draft from the south.

Some of the students helped me watch this swarm, whose sound was inaudible to me, and found the individual flights so irregular that it was a marvel how the swarm kept so definitely in the wall-like formation. The only way to discover the irregularity of flight is to keep one's eyes fixed on some individual silhouetted against the sky for as long as possible, since observation of the swarm as a whole deceives one into thinking the flight much more regular than it is. When one student ran through the wall of midges, they swayed out over the walk as if disturbed, but they swung back into the wall position without the bounding higher already referred to in Schuster's paper. In another swarm near the Dairy power-house, the reverse happened, as they bounded up from the sweep of the net.

By 8 p.m. there were no more midges to catch, the temperature fast falling below 60° F. On June 7, following a cold spell, the wall became more like an irregular box hedge, 14 feet high (4 meters) in places, and on this occasion leaning at an angle of 10° to 15° towards the South, whence came a light breeze. It was still cold but moderating, thus inhibiting flight by 8 p.m. Caught only males again from the swarm east of the Dairy power-house as before.

WEEKS OF DANCING PRECEDE GENERAL MATING IN AT LEAST ONE SPECIES

In 1910 I noted more and more clearly that out of these swarms mates clutch, or seize each other, whether by use of legs or claspers, I could not distinguish. The pairs fall or drift through the air as if by sheer clumsiness, attached tail to tail, so drifting to the ground or the porch screening. Here they usually remained quite a while, unless rolled over and over on some smoother surface, like the cement sidewalk, by light drafts of air. The motion of these rolling flies is similar to the rolling parachutes or plumed seeds of the dandelions. Mates rarely separated in the cyanide bottle, dying in union although, on later drying, they fell apart easily. During the last two days, more and more couples were noted on the sidewalks in the grass and elsewhere, so that this black species seemed to be nearing the height of the mating season. Despite the fact that these swarms had been shrilly humming for the past two weeks, the real mating was in full swing the last two days only. Prof. S. J. Holmes suggests that this delay in mating may be due to the later emergence of the major portion of the female sex, since he has so proved the matter for Culicids. This may explain my failure to note mating couples in 1912, so late as June 7.

AMATIVENESS FAILS TO MAKE MALES COMBATIVE

A second male often attempts to attach himself to a mating pair, but without success, though he walks all over them in his efforts. I was not able to prove that two males ever actually united in polyandrous mating or that they mate with each other, but several times two males seemed to be trying to join claspers as if in homosexuality. Polyandry is affirmed by Mr. T. H. Taylor in Miall and Hammond (1900, the Harlequin Fly, *C. dorsalis*, p. 183). If one male meets another whether alone or pursuing females, the two males seldom attempt to drive each other away as so many males of larger animals will do under similar circumstances. The only exception is when they happen to meet head on, in walking on the porch screen. Then one turns aside for the other, both often changing their further direction. These facts gave an air of aimlessness to their movements. It seems to indicate that

the competition for females is not great nor hostile despite the early abundance of males.

To show the succession of Dipteron mating times, note that spotted-winged Tipulids were having a dance swarm of their own east of the house, at twilight, May 28. One pair was seen grappling each other as if in mortal combat (figured long ago in Reaumur's *Mém.* 1737). I cannot add anything to Ainslee's account (*ib.* p. 27) of the dance except that the dance of this species was not so rapid as I judge he intends to convey in the statement, "a look through the swarm at an object beyond gave the former effect of whirling atoms and rapid motion." Something of this effect is caused at times by the Chironomid dance, rhythmical in part, though the rhythmical pendulous figure-of-eight flight, faster than a pendulum, which Radl ascribes to the "Mücken" (Culicids supposedly Radl. 1901. *Untersuchungen über die Lichtreac-tionen der Arthropoden.* Pflüger's *Arch. f. Phys.* 87, 418-466), was not distinguished.

DURATION OF FLIGHT AND RESTING HABITS

Diurnal. The midges swarm an hour or two in the early morning sunlight, then mostly quit flying and rest on available objects. The number flying before sunset varied daily, but an hour of dusk after sunset seemed to satisfy the swarming activity. In a recent paper on August swarms of *C. plumosus*, the record is made of midges flying to some extent throughout a cloudy day. It seems that even at the height of swarming each day, a majority of all the midges present are perching, some on the grass, on the underside of tree leaves, on the tree trunks and about the house on the clapboards, but especially on the porch screen, at the edges of which hundreds become enmeshed in the many orb spider webs. Of the trees, the majority roost on the underside of the leaves of silver maples, the trees nearest the lake (southeast and north of the house) being completely dotted with them, while few were to be found in the trees in the main grove west of the house. This daytime roost on foliage was carefully noted again June 2, 1912, at Madison.

Nocturnal. My notes would have been full had I appreciated at the time the need of studying swarm duration. E. L. Taschen-

burg (1883, Die Insekten nach ihrem Schaden und Nutzen. Leipzig u. Prague, p. 232, Die Chironomidae oder Zuckmücken) described a swarm which flew from 4 to 9 p.m. I have described in a recent paper a late summer swarm of *C. plumosus* which flew till after midnight. Related forms must vary similarly since Ainslee (1907, Jan. Notes on the Swarming of a Species of Crane Fly (*Trichocera bimaculata*)) noted some crane flies swarming from sunset until over an hour later, when they seemed to be dancing in perhaps larger numbers at a temperature of 45° F. This was November 2, 1906, by the Potomac River, Washington, D. C. At Madison in 1912, the flight was over by 8:30 p.m., May 29; by 8 p.m., May 30; was in a sporadic shape at 7 p.m. on the colder days of June 2, 3, 5 and 6; and was over by 8 p.m.; June 4 and 7, the latter two days being times of large swarms. The real controlling factor will probably reveal itself when some observer studies the dew-point temperature or the minimum temperature at which flight is tolerable. If any observer shall seek further along this line of argument, and cares to correlate with my notes, he can procure complete weather records for my observation period from the Government Weather Bureau Station at Milwaukee, only 6 miles away, or at the University weather station (for 1912), only one-eighth mile away. Although offered their complete records, I have purposely refrained from encumbering the paper with more than brief summaries of weather changes, since I entertain the theory that midges react more to localized influences or stimuli. For the same reason I have omitted complete lists of insects caught.

ANNUAL OCCURRENCE

Taschenberg (ib. p. 233) notes that in dry years midge swarms almost disappear. 1910 and 1912 were wet Mays in Wisconsin. I have noted that the statements of residents about Lake Winnebago, Wis., indicate that midges are quite inconspicuous in some years (*recent paper* on *C. plumosus* Burrill, q. v.). Swarms of *plumosus* seldom last over a week, but of the little black midge most commonly noted in these observations, the period extended over a month. Further deductions on annual duration are hardly safe because of insufficient data at present.

MIDGE HUMMING

During the afternoon of May 24, 1910, the midges did not give vent to the acute buzz noted in the morning, and previously. May it not be that this species, which must have been busy mating at least all the afternoon, judging from the number of couples seen at 6 p.m., discontinues the humming noise when the hours of mating are at their height. In the swarm of June 4, 1912, no sound was noticeable and that despite the absence of mating couples, hence this query appears unfounded in fact. At other times as I approached such a swarm in 1910, the noise distinctly increased; then when I remained motionless, the sound would decrease until inaudible at the distance of a few yards. Morley (l.c.) observed at Monk Soham House, Suffolk, England, that the humming during the lulls of the gusty wind, rose and fell in exact ratio to the proximity of the insects, both sexes of *Tanypus varius* Fabr. and *C. dorsalis* Meig. flying at 9 p.m., July 12, 1909. At 7:45 p.m., August 7, 1912, males only of the above species were flying and made absolutely no audible sound. Further study revealed the fact that two other color phases of midges, one being brown, occasionally came in these swarms; but certainly these few forms were negligible in judging the humming noise of the predominant species. At 7 p.m., June 3, 1912, Professor Sanders and the writer noted some dozen large midges flying with the swarm of tiny midges noted elsewhere. Sound determination was not attempted.

Burmeister, about 1832, is one of the first to note the noise of flies made during flight, according to Westwood (1840, *An Introduction to the Modern Classification of Insects*, vol. 2, p. 496) the latter speaking of the dance flight of gnats in general, although it is a little hard to follow his statements as to whether he always refers to *Chironomus plumosus* which he sets out to describe, or refers to other species also. Since his day several noteworthy papers have appeared, of which the following may be listed:

- MAYER, A. M. 1874 Experiments on the Supposed Auditory Apparatus of the Mosquito. *Am. Nat.*, v. 8, pp. 557-592, fig. 92.
- GRABER, V. 1882 Die chordotonalen Sinnesorgane und das Gehör der Insecten. *Archiv. mikr. Anat.*, bd. 20, pp. 506-640, pls. 30-35, figs. 6; bd. 21, pp. 65-145, figs. 4. Good bibl.

- VOM RATH, O. 1896 Zur Kenntniss der Hautsinnesorgane und des sensiblen Nervensystems der Arthropoden. Zeits. wiss. Zool., bd. 61, pp. 499-539, taf. 23, 24.
- SHIPLEY AND WILSON. 1902 Stridulatory Organs of *Anopheles*, p. 367, in Trans. Royal Soc. Edinb.

ENEMIES OF ADULTS

On the 27th, I noted that a midge had a mite of a bright red color attached to the ventral prothorax. In addition to this parasite we should reckon the spider tribe as their arch enemies, from the thousands of midges entangled in spider webs. Conversely, are the midges not also a nuisance to the spiders, since the webs become overloaded, dangling in long streamers with the midges still squirming along the strands, or whole portions of such ropy web actually falling as a blackened mass to the door steps, even from webs measuring nearly a square foot in area? While the spiders were not seen to suck these flies, they probably did so. In any case, on two occasions, different spiders attempted to cut loose a damaged portion composing such a living rope, and other spiders were frequently seen at dusk trying to respin the snare. Besides the spiders, the English sparrow commonly feeds on them (Burrill, 1913, February, *What is the Present Verdict about the English Sparrow; Stray Notes Original and Otherwise; By the Wayside*, vol. 14, no. 6, pp. 44) and some of the warblers passing northward during the last of May (Burrill, 1912, March, *The Palm Warbler (D. palmarum)*, *By the Wayside*, vol. 13, no. 7, pp. 50-1). The black ant (*Formica fusca* subsp. *subsericea*) is occasionally seen taking a dead midge nestwards.

Especially noteworthy were these ants during the cold weather spell of May 29-June 5. Then these black ants seemed to depend on the midges as their chief food supply above ground, although they frequently forage for dandelion nectar. Many black ants were seen to be carrying dead or dying midges to the nest. Putting spider-web ropes of midges on *Formica* mounds soon proved to the ants that spider web ropes are unbreakable. They attempted to drag the whole rope of midges through the city gates, enlarged for the purpose. On this morning June 7, two black ants were catching live midges on the front gate posts, temporary affairs made out of square tile pipes. The black ants were rather

clumsy at the business, but often succeeded in catching a midge just before it flew, as the midge frequently waited until touched before it took flight. Others flew before a black ant reached them. Could those that did not fly until touched have been sleeping in the sunlight? Such consideration suggests what all the midges may have been doing while at rest after their arduous dances.

August 11, 1912, much greater swarms of midges occurred in the tree-tops about Madison, after several days of cold and rain. On all tree trunks were many dead misshapen and swollen midges of many species. A few were moored by white hyphae to the bark as if some *Empusa culicis* epidemic were rampant. This fungus is reported on as a chief enemy of midges in my *C. plumosus* paper above noted. It remains to add that some midges had swollen out on intersegmental membranes, others were worst on the thorax, and others were completely bloated beyond recognition as to species, the whole body being involved. By August 14, these bloaters were much shrunken by drying.

ECONOMICS AND CONTROL

As regards their economic importance little more can be said than that they are in their immature stages, food for aquatic life, and as adults, food for a few birds. As a nuisance, most of the species do not create the many ills I have elsewhere recorded for *C. plumosus*. Yet our public buildings are often invaded by them, especially where such buildings do not have their large-sized windows properly screened. Prof. A. S. Pearse tells me these flies invade the Michigan Lake Shore Biological Laboratory some nights so that no work can be done.

Until we solve the exact physical control of the midge swarms, it will be impossible to say whether screening a building will be the cheaper preventive from nuisance, or an electric fan or other means which might stimulate their swarms to gather at points away from our besieged human dwellings.

REMARKS ON LITERATURE

These notes are mostly of quantitative value owing to lack of opportunity for exact identification at the time, but in August better observations were made on the enormous swarms of *Chiro-*

nomus plumosus massed along Lake Winnebago and discussed in detail in a recent paper in the *Bulletin of the Wisconsin Natural History Society* (vol. 10, nos. 3-4, December, 1912, pp. 124-163). In this paper, the swarms are likened to smoke to quote Knab's paper from Swinton, 1768. Knab (q. v., for bibliog.) also quotes Taschenberg, 1883, as suggesting that mosquitoes with which Knab's paper mostly deals, do not assume the form of tall columns over trees as often as Chironomids. In none of my observations have the species of Chironomids discussed above taken a good columnar form, a fact which would seem to throw the observations quoted by Knab back upon the Culicid group. Yet Schuster (l.c.) saw *Chironomus plumosus* in columns. He also quotes Moufet, 1634, as seeing Chironomids or Culicids gathered at house gables or over the heads of people passing over bridges. From all that Knab or the present writer has transcribed, the riddle of deciding on the family of insect by the type of swarm, seems insoluble. Knab always saw mosquitoes, while the writer has always seen midges without having observed mosquito swarms. There is good reason to suppose that both observers have reported correctly their own observations and that on this point of swarm type they will have to abandon to oblivion the effort to determine the species noted by ancient writers. Morley (l.c.) quotes, however, from Haliday (1883. *Ent. Mag.* p. 151) as determining a humming swarm as *Culex detritus*, and Douglas (1895. *Ent. Mo. Mag.* p. 239) as another *Culex*.

Radl's papers show that these insects orient themselves towards some definite object, prominent by size or difference in color from surrounding objects, not only "trees, bushes, sign-posts or even heads of grass," but also "over paths through fields or spots of different color in the general ground surface, but not elevated above the surroundings." Packard (1876. *Guide to the Study of Insects*, 370-371, speaks of the midge found along the Massachusetts coast, a salt water species reclassified by Johannsen, 1905, as *Orthocladius oceanicus*. This recalls my having seen an unusual ball of midges dancing in front of a pavillion on the Nahant cliffs at Nahant, Mass., some half mile west of Senator Lodge's residence. This dancing ball some two meters in diameter was observed at twilight (July 24) shortly after a rainy day, 1895. Needham (1908 *N. Y. Sta. Mus. Bull.* 124, p. 171) gives an

interesting account of catching midges in a tent trap placed over Beaver Meadow Brook, Old Forge, New York, from July 16 to August 15, 1905, and relates how spiders interfered with his collecting by getting into the tent first and catching the midges towards the apex, before the entomologists could do their collecting. His data (p. 169) shows that during this period of one month more midges emerged the first half of August than the last half of July. My notes show for a period twice as long (May 7-July 2; observations were continued all through July but were not recorded properly) that most midges emerged the first half of June rather than the last half, that more emerged in this fortnight than during the whole of July or the whole of May. But this conclusion does not apply to August observations owing to my absence in mid-August on a horseback expedition about Lake Winnebago where in lieu of observations for Lake Michigan, I recorded by far the greatest midge swarms ever measured, the swarms being contiguous for over ten miles. This is dwelt on at length, with notes on sound and lack of mating, in the paper already referred to, "Economic and Biologic Notes on the Giant Midge, (*Chironomus plumosus*)" *Bull. Wisconsin Natural History Society* for 1912 (vol. 10, nos. 3-4, pp. 124-163 with bibl. pp. 150-163). For family identifications, I acknowledge the co-operation of the Entomology curators of the Milwaukee Public Museum Dr. S. Graenicher and R. A. Muttkowski. To Prof. J. G. Sanders, State Entomologist, I am greatly indebted for careful revision.

ENTOMOLOGIST'S OFFICE
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August 26, 1913

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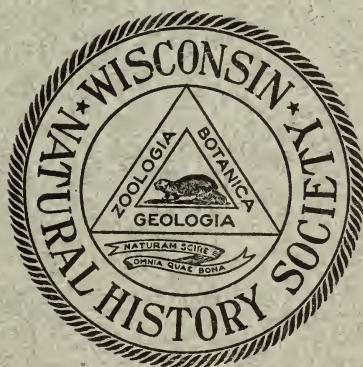
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The Wisconsin Natural History Society

MILWAUKEE, WISCONSIN

ORGANIZED MAY 6, 1857

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Vol. 11

SEPTEMBER, 1913.

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PROCEEDINGS

MILWAUKEE, WIS., February 13, 1913.

Meeting of the combined sections.

President Barth in the chair. Nineteen persons present. Minutes of last regular meeting read and approved.

Mr. Allen reported on the progress of the committee that was appointed at the last meeting.

Messrs. Allen, Mann and Russel remarked on the amount of damage done to growing crops in the northern part of Wisconsin, by the deer which are under state protection.

The assigned topic for the evening was: "Variation as Exhibited by Plants and Animals," Dr. Brinckley opened the discussion by classifying the kinds of variation, and by showing slides illustrating principally the field of vertebrate morphology. Messrs. Mann, Peaslee and Ward gave further illustrations from other fields.

Mr. Ward introduced the subject of the regulation of seal killing. After a general discussion, the motion was passed, favoring the repeal of the present federal law that forbids all seal hunting for the period of five years. The officers of the Society were directed to correspond with the Wisconsin congressmen in regard to this matter.

The meeting then adjourned.

MILWAUKEE, WIS., February 27, 1913.

Regular meeting of the society.

President Barth in the chair. Seventy persons present. Minutes of last meeting read and approved.

Prof. George C. Comstock, Director of the Washburn Observatory and Professor of Astronomy in the University of Wisconsin, gave a very instructive illustrated lecture on the subject "Glimpses of the Sky."

Professor Comstock spoke in particular of the Milky Way, the nebulae, and the components of the solar system.

The Milky Way has a rather complex structure. Supposed to be made up of single stars, and to be of thin depth. It has been suggested that it is made up of clouds with dark rifts or holes. May not these rifts be due to dark, non-luminous bodies lying between the earth and the Milky Way?

Most of the nebulae are thought to be composed of small stars. The spiral nebulae are perhaps the beginnings of solar systems like our own.

The polar caps of Mars are probably due to the effects of freezing. Climate of Mars is arid. The so-called "canals" seem to be observable only with instruments of medium power, and disappear when telescopes of the highest power are used. One explanation as to the cause of the appearance of canals, is that the polar snows melt and cause vegetation to spring up quickly in great abundance. Mars is cooling off; but has not reached the present stage of the earth's physical condition, consequently organic evolution has not progressed so far on its surface.

Jupiter: Its surface cannot be seen because of the thick envelope of clouds, which give to it its peculiar appearance.

Saturn: Rings of Saturn not solid or gaseous, but are composed of small stones.

Halley's Comet is of peculiar interest at present. The earth has just passed through the tail of this comet.

The far side of the moon has never been seen; presumably has about the same appearance as the near side. The parts which have been thought to be seas are now regarded only as depressions. The moon has no atmosphere, no winds, frost, rain, nor erosion.

At the conclusion of the lecture, Professor Comstock was given a vote of thanks by the Society.

A short recess followed, after which the Society took up matters of business. The names of Dr. Wm. S. Marshall, Department of Zoology, University of Wisconsin, and Mr. Ethan A. Cleasby, Portage, Wis., were presented for corresponding membership and were referred to the Board of Directors for action.

The secretary then read letters in reference to the question of seal killing, whereupon a discussion of this subject took place.

Mr. Allen reported on the progress of the committee on state game legislation; and requested the Society to secure a number of copies of the bill providing for the establishment of a state conservation commission through the consolidation of several departments. Mr. Russel was temporarily appointed on the above committee, to act during Mr. Allen's intended absence from the city.

On motion of Mr. Allen, the Society passed resolutions commending the work of the Wisconsin Fish and Game Protective and Propagation League; and directed the secretary to write to the president of this League, relative to the same.

The meeting then adjourned.

MILWAUKEE, Wis., March 13, 1913.

Meeting of the combined sections.

President Barth in the chair. Five persons present. Minutes of last regular meeting read and approved.

The chair announced the coming joint meeting of the Wisconsin Academy of Sciences, Arts and Letters; the Wisconsin Archeological Society;

the Wisconsin Mycological Society; and the Wisconsin Natural History Society. The meeting is to be held in the Public Museum Building, on March 20 and 21.

The secretary, having received a communication from Dr. W. S. Marshall relative to the securing of several volumes of the BULLETIN, brought to the attention of the Society the question of the sale of non-current copies to members. Mr. Muttkowski, the editor of the BULLETIN, said that a precedent had been established to allow a discount to members of 25 per cent on the sale price of each volume. It was thereupon voted that Dr. Marshall be allowed such a discount; and that the matter of giving this discount regularly, be acted upon at the next meeting.

The special assigned topic for the meeting was: "Migration, Natural and Artificial." All persons present joined in the discussion, which touched on a number of groups of both plants and animals.

Dr. Graenicher exhibited a specimen of great interest, especially to those living in the more northern states—that of a flowering spike of the banana plant. He remarked on the methods of dissemination of this plant, and on the structure of the spike, whose large and strikingly colored bracts might, at first sight, be called petals.

The meeting then adjourned.

MILWAUKEE, WIS., April 10, 1913.

Meeting of the combined sections.

President Barth in the chair. Six persons present. Minutes of last section meeting read and approved. The chair announced that the regular meeting for March had been omitted, on account of the joint meeting of the several societies, which was held under the auspices of the Wisconsin Academy of Sciences, Arts and Letters.

The special topic for the evening was: "Tropisms in Plants and Animals." Messrs. Barth, Dernehl, Smith and Heddle participated in the discussion.

Dr. Dernehl recorded an interesting observation made by him at Madison, Wis. He found that ants, unable to crawl up the densely hairy stem of the common pasque-flower in their search for nectar, would climb up near-by grass blades and drop off into the flower cup as the wind swayed the blades towards the plant.

The meeting then adjourned.

THE WILD ASTERS OF WISCONSIN

BY CHARLES E. MONROE

*If you can look into the seeds of time,
And say which grain will grow and which will not,
Speak then to me.*—MACBETH.

INTRODUCTION

The great range of variation exhibited by the American species of the genus *Aster* is well exemplified in the flora of Wisconsin. Side by side with the typical forms occur innumerable variants, departing from the type in different directions. Many of these form connecting links between different species, making it no easy matter to determine the line of separation between one species and another. Some varieties are apparently as stable and as widely distributed as the specific types, and suggest not so much recent as inherited variation, coming down long lines of descent. Others, less stable, may appear spontaneously in connection with the type, anywhere, but do not long retain their distinguishing characteristics. There are recurrent and sporadic variants, which may be reversions to former types, now slowly dying off, or incipient stages of new types in process of inauguration. Differences of hardly definable character often give a different aspect to the same species in different localities. Thinning of timber, drainage of soil, produce marked changes in these plants; and the vicissitudes of the seasons are able to bring about great transformations without any interference by human agencies. In the play of natural tendencies, under the stimulus of changing conditions, and in the struggle for existence amid unfriendly surroundings, new forms are continually emerging and disappearing. No doubt the commoner and more widely distributed forms are the ones best adapted to preservation and perpetuation; but many others must have appeared and disappeared in the long course of evolution, and others are still coming into troubled and uncertain existence—some

perhaps, to secure a permanent footing; others, after a losing struggle, destined to perish forever.

The old notion of a species, as something definite, fixed and stable, nowhere breaks down more completely than when an attempt is made to apply it to the different forms of *Aster* as we find them in this country. Different species are so connected by intermediate forms that we often feel like ignoring specific distinctions and grouping two or more species together under one name. On the other hand, to one of a more analytical bent of mind, the difference between members of a single species may appear so marked that he will be under constant temptation to separate them in still smaller subdivisions and to give to each specific rank. But, whichever course we follow, the different groups into which the genus, or a species, may be divided represent little more than particular tendencies or directions of variation, and the members of each make up a series illustrating the different stages. The word "species," as applied to our North American Asters, can hardly be said to have any other significance than this.

It does not seem a valid objection that under such a definition a single plant might be conceived as belonging to more than one species. The same thing must be true of any scheme which does not involve an infinitesimal splitting up of species. Under any practical system that may be adopted there must inevitably be many plants lying so far outside the norm of any specific type, and yet exhibiting such relationship to several, that they may as properly be included under one as under another of two or more related groups.

With all its apparent capriciousness the genus is nevertheless characterized by a curious sort of persistency. The most unusual varieties may be duplicated in widely separated localities. We shall find in the territory here under consideration several varieties originally assigned to other and much restricted habitats. Among these may be mentioned *A. lateriflorus* var. *hirsuticaulis*, "founded only on specimens from Albany, N. Y.;" *A. ericoides* var. *Pringlei*, "Rocky islands and shores, northern part of Lake Champlain;" *A. concinnus*; *A. vimineus* var. *saxatilis*; *A. umbellatus* var. *latifolius*; and *A. agrostifolius*.

Another interesting fact in this connection is the tendency shown by quite different species to vary in similar directions. Illustrations

tions of this may be found in the hairy varieties of many glabrous species; in the long, stringy branches of certain forms both of *A. sagittifolius* and *A. hirsuticaulis*; and in the tendency of species with normally close inflorescence to throw off loosely branching varieties with scattered heads and elongate slender pedicels.

The causes of these variations are not easily determined. One class of evolutionists ascribes them all to chance; another to differences, or changes, in environment; while another supposes that changes of environment have little other effect than to release the tension under which an unwilling genus has been held by previously fixed conditions, and to restore the free play of its natural exuberance. Hybridism may also play a part in stimulating variation. The solution of these problems will not be reached through speculation merely. Whatever the final conclusion may be, it can only be arrived at when the facts of variation—the directions which it takes, the limitations to which it is subject and the conditions under which its different manifestations occur—are thoroughly understood. Such knowledge can only be gained through patient and long continued observation and through the co-operating labors of many observers.

This paper is the very inadequate result of studies which were begun in the fall of 1902 and have occupied such leisure as could be devoted to them ever since that time. More or less extensive collections have been made in the eastern portion of the state, including Outagamie, Calumet, Sheboygan, Ozaukee, Milwaukee, Racine and Waukesha Counties, and much less extensive ones in Kenosha, Dane, Sauk, Columbia and Door Counties. These have been supplemented to some extent by specimens received from other collectors, among whom should be mentioned Dr. H. V. Ogden, Mr. William Finger, Mr. Howland Russel and Mr. William W. Wight, of Milwaukee, Prof. A. B. Stout, formerly of Wisconsin, now of Columbia University, Mr. H. C. Benke, of Manitowoc, and Mr. Samuel C. Wadmond, of Delavan. In connection with these studies trips have been taken and collections made in northeastern Illinois, northeastern Ohio, western Massachusetts and northwestern Connecticut; and specimens of eastern Asters have been received from Mr. Carl Blomberg, of North Easton, Massachusetts, and from the Biltmore Herbarium at Biltmore, North Carolina. Others have been contributed by personal friends from

the neighborhood of Lake George, New York. The herbaria of the Milwaukee Public Museum, the University of Wisconsin, and the Field Museum of Natural History, of Chicago, have been carefully studied, as well as the private collections of Mr. Wadmond, Mr. Benke, Mr. Finger and Dr. Ogden, whose names have already been mentioned, and that of Dr. Lewis Sherman, of Milwaukee. A single opportunity was also utilized for a hurried examination of the collections of the New York Botanical Garden, at Bronx Park, in the fall of 1907.

Much of the difficulty encountered by earlier collectors in Wisconsin has been due to two causes: one, a lack of familiarity with the *Aster* flora of other portions of the country; the other, the confusion of nomenclature met with in the earlier botanical manuals. The publication of the *Synoptical Flora of North America*, of the Sixth Edition of Gray's *Manual*, of Britton and Brown's *Illustrated Flora*, of Britton's *Manual* and of Gray's *New Manual*, has removed one of these sources of difficulty, and seems to make it possible, with the aid of a better acquaintance with plants from other states, to present a more nearly correct catalogue of the Asters of this state than has hitherto been furnished.

One result of a more comprehensive survey has been the elimination of some species which have been assigned to the state, but which do not seem to occur within its limits. Among these are *A. divaricatus* L., *A. undulatus* L., *A. patens* Ait., *A. turbinellus* Lindl., *A. dumosus* L., and *A. Novi-Belgii* L. On the other hand a number of species not usually credited to Wisconsin must be added to the list, examples being *A. furcatus* Burgess, *A. umbelliformis* Burgess, *A. Schreberi* Nees, *A. Lowrieanus* Porter, *A. Shortii* Lindl., *A. Lindleyanus* T. & G. and *A. concinnus* Willd. To these may be added *A. missouriensis* Britton and *A. agrostifolius* Burgess, as well as a number of varietal forms which have not been recognized by earlier writers.

The previously published lists of Wisconsin Asters are of interest as a part of the history of *Aster* study, and also as illustrating the difficulties under which the study has been carried on. All these lists, so far as they have been brought to the writer's attention—with the exception of Swezey's preliminary list of 1877, supplanted by his Catalogue of 1883—are incorporated in this paper, with explanatory notes in cases where explanation seemed

necessary. These are followed by a revised catalogue based upon the writer's own investigations and, except as otherwise noted, upon specimens contained in his herbarium. Thirty-seven specific types and twenty-four distinguishable varieties are given places in this new catalogue.

PREVIOUSLY PUBLISHED LISTS

The previously published lists of Wisconsin Asters to which reference has been made are contained in the following publications:

I. I. A. Lapham's *Catalogue of Plants Found in the Vicinity of Milwaukee, Wisconsin Territory*, published in 1838; and *Supplement* of 1840.

II. C. C. Parry's *Systematic Catalogue of Plants of Wisconsin and Minnesota*, 1852.

III. I. A. Lapham's *Catalogue of Plants of Wisconsin*, 1853; and *Additions* of 1860.

IV. Th. A. Bruhin's *Vergleichende Flora Wisconsins*, 1876.

V. G. D. Swezey's *Catalogue of the Phaenogamous and Vascular Cryptogamous Plants of Wisconsin*, 1883.

VI. W. M. Wheeler's *Flora of Milwaukee County*, 1888; and *Supplement* of 1889.

VII. L. S. Cheney and R. H. True, *Flora of Madison and Vicinity*, 1893.

VIII. H. F. Lueders' *Preliminary List of Phenogamia and Pteridophyta of the Town of Prairie du Sac, Wis.*, 1895.

IX. Howland Russel's *Check List of the Flora of Milwaukee County*, 1907.

X. S. C. Wadmond's *Flora of Racine and Kenosha Counties*, 1909.

These lists will be given in order in the following pages. An effort has been made to present them as nearly as practicable in the form in which they were originally published. For this reason a few typographical errors appearing in the original lists are allowed to remain uncorrected.

I. I. A. Lapham's *Catalogue of 1838 and Supplemental Catalogue of 1840.*

The earliest list of Wisconsin Asters is contained in *A Catalogue of Plants Found in the Vicinity of Milwaukee, Wisconsin Territory*, which was published by Dr. I. A. Lapham and printed at the *Advertiser* office in Milwaukee in 1838. A prefatory note contains the following direction:

For synonyma, references to authors, &c., see Eaton's *Manual of Botany*, seventh edition, 1836.

This catalogue contains the following Asters, the names of the authors being omitted:

Aster amygdalinus.	puniceus.
Nova-Angliae.	Novi-Belgii.
macrophyllus.	Shortii.

A supplemental catalogue published in 1840 adds the following names:

Aster ledifolius.	cordifolius.
sericeus.	corymbosum.
laevis.	

In these lists *A. amygdalinus* no doubt stands for a broad-leaved form of *A. umbellatus*; *A. Novi-Belgii* represents some member of the *paniculatus* group; and *A. ledifolius* (a synonym for *A. nemoralis* Ait., which does not occur in this state) may have stood for some form of *A. lateriflorus*. These three names are absent from the catalogue of 1853, soon to be noticed, where their places are taken by others here suggested as the ones which were intended.

The catalogue of 1838 contains the first recognition of *A. Shortii* as a Wisconsin plant. It is also included in Lapham's catalogue of 1853, Bruhin's catalogue of 1876, and Swezey's catalogue of 1883. Curiously enough it is omitted from Wheeler's *List of Species Occurring in Milwaukee County*, published in 1888, and from his supplemental list of 1889. It is found in Russel's *Check List of the Flora of Milwaukee County* (1907), and in Wadmond's *Flora of Racine and Kenosha Counties* (1909). In the fifth edition of Gray's *Manual*, published in 1867, the range of this species is given as being from "Ohio to Wisconsin and southward," no doubt on Lapham's authority; but in the later editions of Gray's *Manual*, in Britton's *Manual* and Britton and Brown's *Illustrated Flora*, Wisconsin is not included within its range. It is difficult to understand this omission.

Lapham's supplemental list of 1840 is responsible for the inclusion in later lists, by other authors, of *A. corymbosus* Ait., a synonym for *A. divaricatus* L. This species does not occur in the vicinity of Milwaukee, nor, so far as can be ascertained, anywhere

within the state. It is not included in Parry's catalogue, next to be noticed. Its inclusion in Lapham's list was based upon a mistaken identification. Lapham himself evidently came to the same conclusion later, for it is omitted from his catalogue of 1853. Luckily there is no question as to the plant which was thus designated. *A. divaricatus* is represented in eastern Wisconsin by two closely related species which have been described by Prof. Edward S. Burgess, in his admirable monograph entitled *Species and Variations of Biotian Asters*, under the names of *A. furcatus* and *A. leptocaulis*. The type specimens of *A. leptocaulis* are stated by Professor Burgess to be the following: "plant from Milwaukee, Wis., Dr. H. E. Hasse in hb. N. Y. Bot. Gar.;" and "plant of Milwaukee, Wis., I. A. Lapham, Au., 1842, in hb. Mo. Bot. Gar." A similar plant from Milwaukee County, bearing the name of I. A. Lapham on the label and the designation of *A. corymbosus*, but without any date, is contained in the herbarium of the University of Wisconsin.

A. furcatus and its congener, *A. leptocaulis*, as found in this state, normally occur in the grassy edges of tamarack or black ash swamps, in a black loam resting upon heavy clay, or clay and gravel. *A. divaricatus*, on the contrary, flourishes on rocky, wooded hillsides, or the steep slopes of river gorges. Professor Burgess has found it in ravines cut in the shales in western New York. The writer has collected it in similar ravines or gorges at Conneaut and Ashtabula in northeastern Ohio. Careful search, however, has failed to discover it in similar situations along the banks of the Chagrin River at Willoughby and Chagrin Falls, the Cuyahoga River near Akron, or in the gorges of Rocky River, Black River or Vermillion River, west of Cleveland. It probably finds its western limit in northern Ohio somewhere between Ashtabula and Cleveland.

II. C. C. Parry's Catalogue of 1852

The next list in order of time is found in a *Systematic Catalogue of Plants of Wisconsin and Minnesota*, by C. C. Parry, M.D., made in connection with the Geological Survey of the Northwest, during the season of 1848, and included in the "Report of a Geological Survey of Wisconsin, Iowa and Minnesota; and incidentally of a Portion of Nebraska Territory. Made under Instructions from

the United States Treasury Department. By David Dale Owen, United States Geologist. Philadelphia: Lippincott, Grambo & Co. 1852."

This catalogue contains the following introductory statement:

The order followed is the *Natural System*; and the authority used, "*Torrey and Gray's North American Flora*," and "*Gray's Botany of the Northern United States*."

The following list of Asters and accompanying remarks are taken from this catalogue:

Aster macrophyllus, (L.) Copes. Common throughout the Northwest.

Aster sericeus, (Vent.) August. Dry prairies. Iowa. Barrens of St. Croix.

A characteristic and handsome species, with silvery foliage and rich purple flowers.

Aster laevis, (L.) August. Dry woodlands. Common.

Aster azureus, (Lindl.) August. Dry hillsides. Iowa and Minnesota.

Aster cordifolius, (L.) August. Thickets, St. Croix.

Aster sagittifolius, (Willd.) August. Falls of St. Croix.

Aster multiflorus, (Ait.) September. Dry fields. Iowa.

Aster miser, (Ait.) August. Thickets. St. Croix.

Aster puniceus, (L.) September. Moist ground. St. Croix.

Aster laxifolius, (Nees) August. Bogs. St. Croix.

Aster oblongifolius, (Nutt.) June. Rocky banks of the Mississippi, near Davenport, Iowa.

Aster ptarmicoides, (Torr. & Gr.) August. Dry river bluffs. Mississippi and St. Croix.

Diplopappus umbellatus, (Torr. & Gr.). Thickets of St. Croix.

In this catalogue *A. laxifolius* is probably used as a synonym for *A. junceus* Ait. *A. miser* is a synonym for *A. lateriflorus* L. A noticeable feature is the early blossoming of many species in the latitude of the St. Croix River.

III. I. A. Lapham's Catalogue of 1853 and Additions of 1860

The second volume of the *Transactions of the Wisconsin State Agricultural Society*, published in 1853, contains a series of catalogues of the fauna and flora of the state, prepared by Dr. I. A. Lapham, and bearing witness to his extraordinary industry and the range and accuracy of his learning. The catalogue of plants is introduced by a separate preface, the last paragraph of which reads as follows:

Numerous prepared specimens of Wisconsin plants have, within the last few years, been distributed among the botanists of our own and other countries; and the critical notices kindly returned by them, have been of much assistance in making this enumeration. It embraces one hundred and thirty-six of the natural orders or families, four hundred and fifty-nine genera, and nine hundred and forty-nine species—all found within thirty miles of the city of Milwaukee, unless other localities are mentioned.

Twenty-one species of *Asters* are enumerated in this catalogue, with the names of the authors printed as follows:

- Aster*, Linn. Starwort.
macrophyllus, Linn.
sericeus, Vent.
concolor, Linn. Neenah River, Dr. Houghton.
laevis, Linn.
azureus, Lindl.
Shortii, Boot.
cordifolius, Linn. St. Croix, Dr. Parry.
sagittifolius, Willd.
multiflorus, Ait.
miser, Linn.
tenuifolius, Linn. Upper Mississippi, Dr. Houghton.
praealtus, Poir.
carneus, Nees.
laxifolius, Nees.
puniceus, Linn.
prenanthoides, Muhl.
oblongifolius, Nutt. Upper Mississippi, Torr. & Gray.
Novae-Angliae, Linn.
ptarmicoides, Torr. & Gray.
Diplopappus, Cass.
linariifolius, Hook. Beloit, Mr. T. McElHenry.
umbellatus, Torr. & Gray.

In a list of "Additions to the Flora of Wisconsin," by T. J. Hale, in volume V of the *Transactions of the Wisconsin State Agricultural Society*, published in 1860, the following additional species is given, apparently on the authority of Dr. Asa Gray:

Aster ericoides, L. Wis. Gray.

Of the species named in the foregoing list *A. concolor* is the only one which must be dropped. *A. tenuifolius* has been used as a synonym for *A. Tradescanti* L. and *A. paniculatus* Lam.; *A. praealtus* for *A. salicifolius* Ait.; and *A. carneus* for both *A. pani-*

culatus and *A. salicifolius*. Each of these three species occurs in Wisconsin and "within thirty miles of the city of Milwaukee," and all were no doubt meant to be included in Lapham's list. *A. latifolius* probably stands for *A. junceus*.

IV. Th. A. Bruhin's Catalogue of 1876

Rev. Th. A. Bruhin was a priest of the Catholic Church, educated in Europe, who came to this country, settled first in the village of New Coeln, in Milwaukee County, and afterwards had charge of the parish of St. Wendelin, in Sheboygan County. A paper written by him, under the title *Vergleichende Flora Wisconsins*, ("Comparative Flora of Wisconsin"), was published in the Transactions of the *Kaiserliche Koenigliche Botanische Gesellschaft* of Vienna, in 1876. He did not claim to have added very much to the knowledge of Wisconsin botany by any original investigations of his own, but attempted to compile a list of such plants as he supposed might reasonably be regarded as occurring in Wisconsin in view of the range or *habitat* assigned to them in the current editions of Gray's and Wood's *Manuals*. Species which he believed himself to have collected in the towns of Milwaukee and Lake are marked with a dagger. There were only three such species of *Aster*, and one of these—*A. undulatus*—was an erroneous identification, which has, however, been repeated by later cataloguers.

Bruhin's list of Asters includes twenty-seven species and is as follows:

- Aster corymbosus* Ait. "Common." Gray.
- macrophyllus* L. "Common northward." Gray. (Bei St. Wendelin schon verblueht, als ich sie fand; nach dem Blatt zu schliessen aber doch diese Art.)
- sericeus* Vent. "Wisconsin" nach Gray.
- laevis* L. var. *cyaneus*. "Common northward" nach Gray.
- azureus* Lindl. "Wisconsin" nach Gray.
- Shortii* Boot. "Wisconsin" nach Gray und Wood.
- undulatus* L. Milwaukee County.†
- cordifolius* L. Dasselbst.†
- ericoides* L. "Wisconsin" nach Gray.
- multiflorus* Ait. "Common" nach Gray.
- dumosus* L. "Common." Gray.
- Tradescanti* L. "Very common." Gray.
- miser* L. "Very common and variable." Gray.

- Aster simplex* Willd. "Common." Gray und Wood.
ternifolius L. "Wisconsin" nach Gray.
carneus Nees. "Common." Gray.
aestivus Ait. "Wisconsin" nach Gray.
puniceus L. Eine Meile oestlich von New Coeln.†
prenanthoides Muhl. "Wisconsin" nach Gray.
oblongifolius Nutt. "Wisconsin" nach Gray.
amethystinus Nutt. "Wisconsin" nach Gray.
Novae-Angliae L. "Common." Gray.
graminifolius Pursh. "Lake Superior." Gray.
ptarmicoides Torr. et Gr. "Wisconsin" nach Gray.
angustus Torr. et Gr. "Near the borders of Wisconsin." Gray.
Diplopappus linariifolius Hook. "Common." Gray.
umbellatus Torr. et Gr. "Common." Gray.

The fifth edition of Gray's *Manual* was no doubt one of the authorities relied upon by Bruhin in his compilation. In that edition *A. Tradescanti* stood for *A. vimineus* Lam. (a species the typical form of which is of doubtful occurrence in this state); *A. simplex* for *A. paniculatus* Lam.; and *A. aestivus* for *A. junceus* Ait. *A. graminifolius* is now placed with *Erigeron* under the name of *E. hyssopifolius* Michx. Other names appear to have been used as in Lapham's list of 1853. *A. corymbosus*, *A. undulatus* and *A. dumosus* have not been found in Wisconsin so far as known. None of these three species appear in Lapham's list of 1853.

V. G. D. Swezey's Catalogue of 1883

Volume I, of the *Geology of Wisconsin*, "published under the direction of the Chief Geologist, By the Commissioners of Public Printing," in 1883, contains a *Catalogue of the Phænogamous and Vascular Cryptogamous Plants of Wisconsin*, compiled by Mr. Goodwin D. Swezey. This catalogue was based in part upon a previously published "Catalogue of the Exogenous, Endogenous and Acrogenous Plants of Wisconsin," compiled by the same author in 1877, which was in the nature of a preliminary report and is supplanted by the later one here given. Gray's *Manual* (no doubt the fifth edition) was the authority relied upon. A prefatory note contains the following paragraph:

This catalogue is in part a compilation, and the author has not been able to follow the strict and perhaps the better rule of including only such species as have passed under his eye or are preserved in herbaria accessible

to the botanist. The early lists from the state, published by Dr. I. A. Lapham and T. J. Hale, have been incorporated, although including some species not since reported, mostly from the less accessible parts of the state; some of these may possibly have disappeared from the localities where they were found.

The following species and variety, thirty-one in all, are listed in this catalogue:

Aster corymbosus, Ait.	Aster simplex, Willd.
macrophyllus, Linn.	tenuifolius, Linn.
sericeus, Vent.	carneus, Nees.
concolor, Linn.	aestivus, Ait.
patens, Ait.	longifolius, Lam.
laevis, Linn.	puniceus, Linn.
azureus, Lindl.	“ var. vimineus, Gray.
Shortii, Boot.	prenanthoides, Muhl.
undulatus, Linn.	oblongifolius, Nutt.
cordifolius, Linn.	amethystinus, Nutt.
sagittifolius, Willd.	Novae-Angliae, Linn.
ericoides, Linn.	ptarmacoides, Torr & Gray.
multiflorus, Ait.	Diplopappus linariifolius, Hook.
dumosus, Linn.	umbellatus, Torr. & Gray
Tradescanti, Linn.	amygdalinus, Torr. & Gray
miser, Linn., Ait.	

A. corymbosus, *A. concolor*, *A. patens*, *A. undulatus* and *A. dumosus* are all based on earlier erroneous identifications. *A. longifolius* in the fifth edition of Gray's *Manual* is said to have stood for *A. Novi-Belgii* L., a species which can hardly occur in Wisconsin. Just what was intended by that name is a matter of conjecture. *A. puniceus* var. *vimineus* is stated in the *Synoptical Flora* to have been used in Torrey and Gray's *Flora of North America* as a synonym for *A. puniceus* var. *lucidulus*. *Diplopappus amygdalinus* is a synonym for *A. umbellatus* var. *latifolius* Gray. Other synonyms are used as in previous lists.

VI. W. M. Wheeler's Catalogue of 1888 and Supplement of 1889

The *Proceedings of the Natural History Society of Wisconsin*, published at Milwaukee in April, 1888, contain an article on *The Flora of Milwaukee County*, with a list of species occurring in that county, by Dr. W. M. Wheeler, at that time curator of the Milwaukee Public Museum. The list includes thirteen Asters, with notes on their distribution, as follows:

- Aster corymbosus*, Ait. On the Banks of the Milwaukee River.
A. macrophyllus, L. Scattered through the county.
A. laevis, L. Like the last.
A. undulatus, L. Milwaukee County. (Bruhin.)
A. cordifolius, L. Abundant, especially at Whitefish Bay.
A. sagittifolius, Willd. Found by Mr. A. Conrath in the county.
A. Tradescanti, L. Like the last.
A. longifolius, L. Whitefish Bay.
A. puniceus, L. Common throughout the county.
A. prenanthoides, Muhl. Whitefish Bay.
A. Novae-Angliae, L. Abundant near the cement works, where a few specimens of the var. *roseus* were also found.
A. ptarmacoides, T. & G., Near Larkin's tamarack swamp.
A. augustus, T. & G. In the streets of the city.

In a supplemental paper published in the *Proceedings of the Natural History Society of Wisconsin* in April, 1889, Dr. Wheeler acknowledges the assistance he has received from Mr. Conrath and Mr. F. Runge and adds the following species to the above list:

- Aster miser*, Ait. Common in various parts of the county.
A. simplex, Wild. In Larkin's tamarack swamp.

From this very incomplete list *A. corymbosus* and *A. undulatus*, must be dropped. *A. ptarmicoides* is of doubtful occurrence in the county. The fifth edition of Gray's *Manual* was no doubt used in the preparation of this list and the remarks upon synonyms used in earlier catalogues apply to some of the species above named.

In later BULLETINS of the Wisconsin Natural History Society some additions to this list were contributed by Mr. W. J. Ben-
 netts.

The BULLETIN for July, 1900, contains the following:

- Aster azureus*, Lindl. In Menomonee Valley and along Milwaukee River.
A. shortii Hook. With the last in Menomonee Valley and northwest part of county.
A. lowrieianus Porter. Common around Milwaukee along with *A. cordifolius* which it much resembles.

The bulletin for January, 1902, adds the following:

- Aster ericoides* L. In Section 6 Town of Greenfield near Waukesha County line and near Cement Works along C. & N. W. Railway.

No specimens of *A. azureus* or *A. ericoides* from the localities above mentioned have been preserved and the identification of these species from Milwaukee County must be considered very doubtful.

VII. *L. S. Cheney and R. H. True, 1893*

Volume IX of the *Transactions of the Wisconsin Academy of Sciences, Arts and Letters*, published in 1893, contains a paper entitled *On the Flora of Madison and Vicinity, a preliminary paper on the Flora of Dane County, Wisconsin*, by Messrs. L. S. Cheney and R. H. True. This paper names sixteen species of Asters, with notes on their distribution, as follows:

Aster. L. Starwort. Aster.

A. Novae-Angliae, L. Low wet pastures. Very common.

A. sericeus, Vent. Growing on dry rocky points about Madison. Local.

A. azureus, Linde. On sandy or gravelly soil. Not common.

A. sagittifolius, Willd. Dry grounds throughout the region. Common.

A. turbinellus, Lindl. Common on dry soil.

A. laevis, L. Dry gravelly or sandy places. Not common.

A. multiflorus, Ait. Not uncommon in dry soil along fences and in copses.

A. diffusus, Ait., var. *hirsuticaulis*, Gray. Everywhere common in fields and thickets.

A. Tradescanti, L. Low grounds. Not rare.

A. paniculatus, Lam. Common in low lands.

A. longifolius, Lam. (of Gray's *Man.*, 6th ed.) Growing in rich low lands. Rather common.

A. Novi-Belgii, L. Occurring occasionally throughout the region.

A. puniceus, L. Low thickets and swamps. Very abundant.

A. umbellatus, Mill. Low moist thickets. Not rare.

A. linariifolius, L. Sandy hillsides west of Madison. Rare.

A. ptarmicoides, Torr. & Gray. Dry hills about Madison. Rather local.

A. turbinellus in the foregoing list is unquestionably an erroneous identification. The University herbarium contains two specimens collected by the late John W. Dunlop, without date or locality, labeled *A. turbinellus*, which are plainly forms of *A. laevis*. Both leaves and heads are entirely unlike those of the former species. In the same herbarium is a specimen collected at Madison in 1892 and labeled *A. Novi-Belgii*, which perhaps belongs to *A. longifolius*. Other specimens under the latter name seem to be correctly labeled. A specimen collected by "Cheney & True" at Madison

in 1892 and labeled *A. Tradescanti*, belongs to the *heterophylli* and should probably be assigned to *A. sagittifolius*. Probably all the species named in this list may be found in Dane County with the exception of *A. turbinellus* and *A. Novi-Belgii*. A revised list, however, is much to be desired.

VIII. H. F. Lueders' List of 1895

A Preliminary List of *Phenogamia* and *Pteridophyta* of the Town of Prairie du Sac, Wis. (in Sauk County), by Mr. Herman Frederick Lueders, is contained in volume X of the *Transactions of the Wisconsin Academy of Sciences, Arts and Letters*, published in 1895. Sixteen species of Asters are enumerated in this list, as follows:

<i>Aster grandiflorus</i> L.	<i>Aster dumosus</i> L.
oblongifolius Nutt.	diffusus Ait.
Novae-Angliae L.	Tradescanti L.
sericeus Vent.	longifolius Lam.
azureus Lindl.	puniceus L.
sagittifolius Willd.	umbellatus Miller.
laevis L.	linariifolius L.
multiflorus Ait.	ptarmicoides T. & G.

Aster grandiflorus in this list is of course an erroneous identification. There are in the University herbarium two specimens, one from Dane, the other from Rock County, bearing the same name, but appearing to be very narrow-leaved plants of *A. oblongifolius*, with glandular bracts. It may be that a similar plant is here intended. *A. dumosus* is probably another mistaken identification. The writer has not seen any specimens of this species from Wisconsin. *A. diffusus* is a synonym for *A. lateriflorus*.

IX. Howland Russel's List of 1907

Next in point of time is a *Check List of the Flora of Milwaukee County*, very carefully compiled by Mr. Howland Russel, and published in 1907 in the December BULLETIN of the Wisconsin Natural History Society. The nomenclature for the most part is the same as in Gray's *New Manual*, then about to be published, the editors of which are said to have assisted in bringing the names

up to date. Where the names so given differ from those used in the second edition of Britton's *Manual*, the latter are inserted as synonyms and printed in italics. Twenty-five species and varieties of *Aster* are listed, with notes on their distribution, as follows:

- Aster divaricatus* L. White Wood Aster. Banks of Milwaukee River.
A. leptocaulis Burgess. Smooth-stemmed Aster. Lake Woods and Whitefish Bay.
A. macrophyllus L. Large-leaved Aster. Throughout county. Locally abundant.
A. Shortii Hook. Short's Aster. Throughout northern part of county. Locally abundant.
A. azureus Lindl. Sky-blue Aster. Menomonee Valley and Milwaukee River. Occasional.
A. cordifolius L. Common Blue Wood Aster. Throughout county. Locally abundant.
A. cordifolius L. var. *laevigatus* Porter. *A. Lowrieanus* Porter. Smooth Wood Aster. Throughout county. Common.
A. sagittifolius Willd. Arrow-leaved Aster. Reported by A. Conrath as found in county.
A. Drummondii Lindl. Drummond's Aster. Wauwatosa and Whitefish Bay. Locally abundant.
A. undulatus L. Wavy-leaved Aster. Whitefish Bay and New Coeln.
A. novae-angliae L. New England Aster. Near the Cement Works, at Lake Woods and Whitefish Bay. Locally abundant.
A. puniceus L. Red-stalk Aster. Throughout county. Common.
A. puniceus var. *lucidulus* Gray. Sec. 5, Greenfield.
A. prenanthoides Muhl. Crooked-stem Aster. Throughout county. Not uncommon.
A. laevis L. Smooth Aster. Throughout county. Abundant, especially north.
A. junceus Ait. Rush Aster. In western part of county. Locally abundant.
A. longifolius Lam. Long-leaved Aster. Whitefish Bay.
A. ptarmicoides (Nees.) T. & G. Upland White Aster. Sec. 1, Greenfield.
A. paniculatus Lam. Panicked Aster. Banks of Milwaukee River.
A. paniculatus var. *simplex* (Willd.) Burgess. Sec. 1, Greenfield.
A. Tridacanti L. Michaelmas Daisy. Wauwatosa and Whitefish Bay. Occasional.
A. ericoides L. Frost-weed Aster. Cement Works on Milwaukee River. Sec. 6, Greenfield.
A. lateriflorus (L.) Britton. Starved Aster. Throughout county. Locally common.
A. angustus (Lindl.) T. & G. *Brachyactis angustus* (Lindl.) Britton. Rayless Aster. In waste places in city. Spreading.

Doellingeria umbellata (Mill.) Nees. Tall Flat-top White Aster.
Menomonee Valley and Whitefish Bay. Locally abundant.

A. divaricatus and *A. undulatus* must certainly be omitted from this list. *A. azureus* and *A. ericoides* are inserted on the doubtful authority of Mr. W. J. Bennett's additions, previously noticed, to the flora of the County. They have not been noticed by any other observers in Milwaukee County and in the absence of any authentic specimens must be dropped from this list; as must also *A. ptarmicoides*, until further confirmation of its occurrence has been obtained.

X. S. C. Wadmond's List of 1909

Volume XVI, part II, no. 1, of the *Transactions of the Wisconsin Academy of Sciences, Arts and Letters*, published in 1909, contains a very valuable paper by Mr. Samuel C. Wadmond, of Delavan, entitled: *Flora of Racine and Kenosha Counties, Wisconsin: A List of the Fern and Seed Plants Growing Without Cultivation*. This list is based for the most part upon the writer's own observations and collections and, except where otherwise noted, upon preserved specimens in his own herbarium. The only identifications which seem to be clearly wrong are some for which reliance was placed upon the reports of other collectors, including the writer of the present paper. Twenty-six species and varieties are included in the list of Asters, which is as follows:

Aster divaricatus, L. (*A. corymbosus* Ait.) Rare; Dr. Davis (Suppl. List of Parasitic Fungi of Wisc. p. 157) reports collecting this as the host of an *Erysiphe*. The writer has not seen this *Aster* within our area.

Aster macrophyllus, L. Common; woodlands.

Aster Shortii, Hook. Frequent; dry banks and wood borders.
A southern species finding its northern limits in Southern Wisconsin, which extends somewhat the range allotted to it in Gray's Manual and the Ill. Flora.

Aster azureus, Lindl. Common; prairies.

Aster cordifolius, L. Rare; known to the writer from a single station only, fence-row in shade, Ives, Racine County.

Aster Drummondii, Lindl. Common; open woods and roadsides.

Aster sagittifolius, Willd. Rare; in thin soil underlain by limestone at Horlicksville quarries, Racine County. The only known station.

Aster Novae-Angliae L. Common; moist grounds.

- Aster amethystinus*, Nutt. Rare; one colony known from pasture-land near De Koven Ave., Racine. The only station.
- Aster puniceus*, L. Common; swamps, ditches and wet places.
- Aster prenanthoides*, Muhl. Rare; roadside, along 12th Street, Racine. Not seen elsewhere.
- Aster laevis*, L. Common; dry prairies and roadsides.
- Aster longifolius*, Lam. Rare; swamps and moist woods.
- Aster sericeus*, Vent. Rare; prairies and dry banks, Gatliff and Burlington, Racine County.
- Aster ptarmicoides*, T. & G. Common; prairies.
- Aster ptarmicoides*, T. & G., var. *lutescens*, Gray. Rare; a sheet in herb. of C. E. Monroe, Milwaukee, Wis., collected on prairie near Gatliff, Racine County. The writer has never seen this yellow-flowered form.
- Aster salicifolius*, Lam. Common; low grounds.
- Aster paniculatus*, Lam. Common; low grounds.
- Aster Faxoni*, Porter. Rare; I include this on the statement of C. E. Monroe of Milwaukee, who has specimens of this species in his herbarium from Zion City, Ill., and says it undoubtedly comes over the line into Kenosha County, although he has no specimens from our area.
- Aster diffusus*, Ait. (*A. lateriflorus*, Britton) Common; roadsides and wood-borders.
- Aster diffusus*, Ait. (*A. lateriflorus*, Britton) var. *thyrsoides*, A. Gray. Common; roadsides and shaded thickets.
- Aster vimineus*, Lam. Dr. Davis (2nd Suppl. List Parasitic Fungi of Wis., pg. 169) reports a *Septoria* on this host, collected at Racine.
- Aster multiflorus*, Ait. Common; fields and roadsides, in dry soil.
- Aster commutatus*, A. Gray (Syn. Fl. 1: Part 2, 185, 1884) (*A. incanopilosus*, Sheldon). C. E. Monroe, Milwaukee reports having this specimen collected by him west of Corliss, Racine Co., on C. M. & St. P. right of way.
- Aster angustus*, T. & G. (*Brachyaetis angustus*, Britton). Frequent; waste places, introduced from the west and spreading rapidly.
- Aster umbellatus*, Mill. (*Doellingeria umbellata*, Nees.) Common; moist prairie thickets and low grounds.

Mr. Wadmond's collection of Asters, which has been submitted to the writer for examination, proves to contain a specimen of *A. furcatus* Burgess, from Kenosha County. This is possibly the species which Dr. Davis had previously identified under the name of *A. corymbosus* Ait., for which Professor Burgess's name must be substituted. Its discovery in Kenosha County extends the previously known range.

The occurrence of typical *A. vimineus* at Racine is doubtful.

The conjecture in reference to the occurrence of *A. Faxoni* in Kenosha County, above alluded to, has not yet been confirmed.

The plants designated under the name of *A. commutatus* are perhaps nothing more than unusually luxuriant individuals of *A. multiflorus*, with larger leaves and heads than in the typical form, but lacking the number of rays characteristic of *A. commutatus*. Mr. Wadmond's specimens of *A. cordifolius*, *A. sagittifolius* and *A. lateriflorus* var. *thyrsoides*, are all peculiar forms with much pubescence and somewhat difficult of exact identification. The identification of *A. longifolius* is also somewhat doubtful.

REVISED CATALOGUE OF WISCONSIN ASTERS

***Aster furcatus* Burgess**

***A. leptocaulis* Burgess**

As distinguished by Professor Burgess, the two species above named differ in the character of the inflorescence, as relatively leafy or bare; in the relatively hispid or velvety character of the pubescence which clothes the lower surface of the leaves; and in the relative roughness or smoothness of the stem. The first species is assigned by the author just named to "shaded cliffs and woods" in Illinois and Missouri; the second to the neighborhood of Milwaukee. The two species seem to run into each other. Hispid forms occur in exposed situations which do not seem to be distinguishable from the Illinois species, of which a number of specimens are to be found in the collections of the Field Museum of Natural History. Forms with softer pubescence are found in moister and more shaded locations. The writer has specimens of these species from Milwaukee, Ozaukee and Waukesha Counties. Mr. S. C. Wadmond's herbarium contains a specimen of *A. furcatus* (not recognized by him at the time of the publication of his *Flora of Racine and Kenosha Counties*, in 1909) from Kenosha County. A specimen of the same species, from Kewaunee County, is included in the J. H. Schuette herbarium, recently acquired by the Field Museum of Natural History. Another has recently been collected by Mr. Benke in Sheboygan County and donated to the Milwaukee Public Museum.

A. Schreberi Nees

A. umbelliformis Burgess

A. ambiguus Bernh. in Nees

The first of these names is used here, as in Gray's *New Manual*, to include a great variety of Biotian Asters, distinguished from the *macrophyllus* group by white rays and the absence of capitate glands. The only portion of the state in which plants of this character are known to occur is a narrow and interrupted area, a little over two miles in total length, extending from the northern limits of the city of Milwaukee to the woods west and north of the Whitefish Bay resort. In this limited territory they occur in great profusion and exhibit a great variety of forms. The principal differences are found in the size and shape of the leaves and sinus, the proportion of winged and naked petioles, size of heads, length of rays and character of bracts. Two lines of variation are distinguished, by the tendency, on the one hand to corymbose, and on the other, to paniculate ramification. In the former the stem seems to bend away from the branches, giving at each joint an appearance of bifurcation; in the other the central axis stands erect. These differences, however, do not always seem to be fixed or permanent. The whole *facies* of the group changes from year to year and a series of plants collected during many successive seasons presents a polymorphic, or metamorphic, aspect of a very peculiar character. These facts, as well as the limited area to which the plants are restricted, suggest caution in any attempt to separate them under specific designations.

There are, however, plainly recognizable within the group, plants which answer very closely to two of the species which are described in Professor Burgess's monograph. One of these, *A. umbelliformis*, has maintained its characteristic aspect during a number of successive seasons, but is restricted to a single locality in the woods at Whitefish Bay. The other, *A. ambiguus*, was only noted in Lake Woods in 1903 and 1904, since which time it has given place at the same locality to plants of a less definite character. Among the many other forms are some suggesting with more or less closeness of approximation the species distinguished by Professor Burgess under the names of *A. curvescens*, *A. vittatus*, *A. Eriensis*, *A. glomeratus*, *A. Julianus*, *A. limicola*, *A. rectifolius* and

A. sylvicola. Others occur which are quite distinct from any of the foregoing. Hybridism with plants of the *macrophyllus* group, as well as within the non-glandular group itself, undoubtedly occurs and may account for some of the variations; but the character and extent of such hybridism cannot be definitely determined until a more complete determination of specific types has been established for this locality.

***A. macrophyllus* L.**

***A. macrophyllus* var. *sejunctus* Burgess**

This species, in one or another of its protean forms, is found throughout the eastern portion of the state and no doubt occurs in most wooded sections. It has been collected in Sauk County, but is not included in Cheney and True's Dane County list. The variety *sejunctus*, with hairy stems, has been collected in Outagamie, Ozaukee, Milwaukee and Waukesha Counties, and Professor Burgess notes a specimen from Juneau County in the Columbia University herbarium. Many other forms occur which suggest Professor Burgess's species *A. biformis*, *A. uniformis*, *A. elaeagnius*, *A. roscidus*, *A. ianthinus*, *A. multiformis*, *A. quadratus* and *A. granulatus*. Others seem quite distinct from any species or variety hitherto described. Plants with greasy leaves occur in Milwaukee County and may belong to the variety *pinguifolius* which is credited to Wisconsin by Professor Burgess.

There is found at Whitefish Bay a group of *Asters* intermediate in character between *A. Schreberi* and *A. macrophyllus*, distinguished from the former by the presence of capitate glands, and from the latter by the possession of pure white rays. An interesting series of such plants has been collected, beginning with forms with membranous leaves, narrow heads and delicate bracts, and ending with luxuriant forms, with heads of unusual size and rays of unusual length, and with some of the bracts slightly reflexed. Whether these are hybrids, or whether they mark a hitherto unnoted stage in evolution, has not been determined.

***A. oblongifolius* Nutt.**

The writer is indebted to Prof. A. B. Stout for a specimen of this species collected in Sauk County. The Milwaukee Public Museum possesses two small plants of the same species which were

collected by the late Thure Kumlien in Waukesha County. One of these was labeled *A. oblongifolius* by the collector, and bears a note stating that specimens taken at the same time and place had been "determined by Dr. Gray." This was collected in 1860. The other specimen is labeled *A. amethystinus*. There are two specimens in the Wisconsin University herbarium, one from Dane, the other from Rock County, originally labeled *A. grandiflorus*, which are distinguished by unusually narrow leaves. All the specimens above referred to are characterized by glandular bracts.

A. Novae-Angliae L.

Specimens of this species from Brown County are included in the J. H. Schuette collection, and one from LaFayette County is in the Wisconsin University herbarium. It is a very common species in eastern Wisconsin and is included in every list of Wisconsin plants except that of C. C. Parry. It would be interesting to know if there is any county in which it does not occur.

A. sericeus Vent.

Mr. Wadmond has collected this species in Racine County. In the Milwaukee Public Museum there are specimens from Jefferson, Waupaca, Burnett, Pierce and Grant Counties. It has been collected in Waushara County by Dr. Ogden. The writer has specimens from Sauk, Monroe and Waukesha Counties. Some of the specimens from Sauk County have pure white rays. There is a specimen in the University herbarium at Madison, collected by I. A. Lapham, and labeled as coming from Milwaukee County. No date is assigned to this specimen, and it must be remembered that in the early days of Dr. Lapham's explorations Milwaukee County embraced the territory now included in Milwaukee and Waukesha counties.

A. azureus Lindl.

This species has a wide distribution in Wisconsin, but so far as known does not occur in Milwaukee County. It is possible that among the writer's collections are included specimens of *A. capillaceus* Burgess—as described in Small's *Flora of the Southeastern United States*—with less roughened stem and leaves and larger heads than in the type (Elkhart Lake, Sheboygan County and

Berryville, Kenosha County); and of *A. poaceus* Burgess—also described in the *Flora of the Southeastern United States*—with profuse ramification, small heads and greatly elongated narrow leaves (Sauk County); although the specimens referred to do not exactly meet the requirements of these descriptions. Other curious forms are found at High Cliff, in Calumet County. Besides the localities already named the writer has collected *A. azureus* in Racine, Dane and Waukesha Counties. The Milwaukee Public Museum has specimens from Jefferson, Manitowoc and Burnett counties. Dr. Ogden has collected it in Waushara County. The J. H. Schuette collection has specimens from Brown County. Mr. Benke has collected it in Portage County. Other localities are represented in the Wisconsin University collections. The rays of this species are apt to turn deep blue in drying, but the writer has never observed them of that color in the growing plant.

A. Shortii Lindl.

Bluish, rose-tinted and pure white rays are found in this species. The writer has specimens from Kenosha, Racine, Milwaukee, Waukesha, Ozaukee, Sheboygan and Outagamie Counties. It has lately been collected by Mr. Benke in Manitowoc County, and it was collected by J. H. Schuette in Brown County—which, perhaps, marks the northern limit of its range. Certain peculiar dwarfed forms from Milwaukee County may be hybrids between this species and *A. Drummondii*.

A. cordifolius L.

A. Lowrieanus Porter

Plants which entirely satisfy the descriptions of *A. cordifolius* and *A. Lowrieanus* are comparatively rare and form only a small portion of a large and widely distributed group most of whose members are of intermediate character and refuse to conform strictly to either type. For this reason it is not always easy to decide in which of these species the many forms which must be assigned to one or the other should be placed. *A. Lowrieanus*, with its gradually narrowed leaf bases, alate petioles and loose inflorescence, seems to be a connecting link between several of the different species which have been grouped together under the common name of *heterophylli*. In the particulars just mentioned it

bears a striking resemblance to *A. Lindleyanus*; it runs easily into forms suggestive of *A. sagittifolius*, and *A. Drummondii*; and it grades almost insensibly into the dealate forms characteristic of *A. cordifolius*. *A. cordifolius*, *A. Lowrianus*, and *A. sagittifolius*, as found in eastern Wisconsin, all tend to produce variants with pubescent stems, and leaf surfaces pilose below and rough above, which are not easily distinguishable from each other, and seem to be included under the comprehensive designation of *A. Drummondii*.

Plants of the "intermediate character" above mentioned occur in many portions of the state. These are for the most part considered as properly assigned to *A. cordifolius*, although generally lacking the roughness of leaf which is given as characterizing that species. Certain forms, however, occurring in Milwaukee County, with succulent leaves and alate petioles—although less broadly alate than in the type—are assigned to *A. Lowrianus*.

A number of singular forms collected October 11, 1902, on the wooded slopes of a bluff running down to the Menomonee River at Park Hill, just west of the Milwaukee city limits, bear a striking resemblance to a specimen of *A. choralis* E. S. Steele in the herbarium of the Field Museum of Natural History.

A. sagittifolius Wedemeyer

The writer's herbarium contains specimens of this species from Waushara, Outagamie, Calumet, Sheboygan, Ozaukee, Milwaukee, Waukesha, Dane, Rock, Racine and Sauk Counties. Those from Waukesha and Waushara Counties were collected by Dr. H. V. Ogden; those from Sauk County by Prof. A. B. Stout. White is the prevailing color of the rays, but plants with tinted rays are also found. The species presents many peculiar varieties, some of which are extremely hispid. It is probable that the varieties *dissitiflorus* Burgess and *urophyllus* (Lindl.) Burgess are represented in eastern Wisconsin. Many plants with widely divaricate branches have the narrow bracts of this species but a manner of growth entirely different from the typical form.

A. Drummondii Lindl.

This species, in the comprehensive signification above indicated, is found all through eastern Wisconsin, from Ozaukee County to

the Illinois state line, and no doubt occurs over a large portion of the state. It runs into, or is associated with, several curious forms, some of which are quite glabrous. Hybrids between this species and *A. lateriflorus* occur at Lake Woods, in Milwaukee County.

A. Lindleyanus T. & G.

A. Lindleyanus var. comatus Fernald

This species grows abundantly at Kaukauna, Outagamie County, where it is associated with *A. Shortii*. The writer also has specimens from Door County, collected by Dr. Ogden, and from Iron County, where it was collected by Mr. William W. Wight. The late J. H. Schuette collected it in Brown and Oconto Counties. The University herbarium contains specimens from Wood, Price, and Marathon Counties. The writer also has specimens from Mackinac Island and from Duluth. This indicates a range extending entirely across the northern portion of the state. The variety *comatus* has been collected in Outagamie and Iron Counties.

A. laevis L.

A. laevis var. amplifolius Porter

This very variable Aster is widely distributed. The variety has been collected in Milwaukee and Racine Counties. Among less common variants are some with lucid leaves; some with cordate leaves; and others with spreading and downward curving branches, sharply serrate leaves and somewhat secund inflorescence (all from Milwaukee County). Some of these suggest hybridism, as do also some specimens from Kaukauna with a suspicious resemblance to *A. Lindleyanus* in the character of their inflorescence and bracts. A manifest hybrid between this species and *A. Drummondii* has been found at Lake Park in the city of Milwaukee. Other specimens which seem to be hybrids between the same species have been collected at Mineral Spring Park, at the northern limits of the city. These bear a certain resemblance to *A. azureus*, which, however, is not known to occur in Milwaukee County. Other peculiar forms occur, sometimes with corymbose inflorescence, as at Elkhart Lake, in Sheboygan County.

A. concinnus Willd.

Narrow-leaved plants with pubescent branches, small heads and pale rays, from woods near Whitefish Bay, Milwaukee County, may be assigned to this species, which is characterized by Gray as an ambiguous one. These specimens strongly suggest hybridism between *A. laevis* and a hairy form of *A. lateriflorus*. Some broad-leaved plants from Milwaukee and Sheboygan Counties have similar small heads, pale rays and pubescent branches.

A. ericoides L.**A. ericoides var. villosus (Michx.) T. & G.****A. Pringlei (Gray) Britton**

Mr. H. C. Benke has contributed specimens of *A. ericoides*, from Waushara County, to the Milwaukee Public Museum. The variety *villosus* has been collected by Professor Stout in Sauk County. *A. Pringlei* grows on the rocks, and more luxuriantly on the bank above the rocks, at the Dells of the Wisconsin River in Columbia County. Plants intermediate in character between *A. Pringlei* and *A. polyphyllus* Willd. have been collected at North Bay, in Door County, by Mr. Howland Russel, Dr. Charles F. Millspaugh, of the Field Museum of Natural History, and by the writer. Some of these have hairy stems. Specimens of similar indefinite character were collected by Mr. Schuette in Brown County.

A. amethystinus Nutt.

Mr. S. C. Wadmond's herbarium contains a fine specimen of this species which was collected in Racine County. The writer has not seen any other specimen from this state. Quite a number of specimens in the Field Museum of Natural History, from various localities outside of Wisconsin, bear the label *A. amethystinus*, but only two of them seem to the writer to belong to this species. The others are rigid and harsh, and, although not apparently glandular, may belong to the variety *rigidulus* Gray of *A. oblongifolius*.

A. multiflorus Ait.**A. multiflorus var. exiguus Fernald**

The species is widely distributed in eastern Wisconsin, but is apparently of rare occurrence in Milwaukee County. The variety

has been collected in Racine County and by Mr. Schuette in Brown County. Luxuriant forms collected by the writer in Racine County, by Mr. William Finger in Waukesha County and by Mr. Schuette in Brown County, are suggestive of *A. commutatus* (T. & G.) Gray, in the larger size of the heads and leaves, but lack the number of rays characteristic of that species.

***A. vimineus* var. *foliolosus* (Ait.) Gray**

***A. vimineus* var. *saxatilis* Fernald**

The type of this species has not been observed by the writer in this state. Plants collected by Mr. William Finger in Monroe and Trempealeau Counties are referred to the variety *foliolosus*. The variety *saxatilis* has been collected in Outagamie and Ozaukee Counties. Plants intermediate between *A. vimineus* and *A. Tradescanti* are not uncommon in Outagamie, Sheboygan, Ozaukee, Columbia, Milwaukee and Kenosha Counties, but are not easily referable to either species.

***A. lateriflorus* (L.) Britton**

***A. lateriflorus* var. *glomerellus* (T. & G.) Burgess**

***A. lateriflorus* var. *thyrsoides* (Gray) Sheldon**

***A. lateriflorus* var. *bifrons* (Lindl.) Gray**

***A. lateriflorus* var. *pendulus* (Ait.) Burgess**

***A. lateriflorus* var. *horizontalis* (Desf.) Burgess**

All the above named forms of *A. lateriflorus* seem to occur in eastern Wisconsin, as well as several others which refuse to subscribe to any of the foregoing denominations. The variety *glomerellus* is simply a form with shortened or aborted branches. Similar forms occur of the variety *pendulus* and *A. hirsuticaulis*. A single specimen, which is assigned to the variety *thyrsoides*, was collected in the railroad yards near Mitchell Park in the city of Milwaukee. The variety *bifrons* occurs in Outagamie, Milwaukee and Waukesha Counties; the variety *pendulus* in Outagamie, Sheboygan, Ozaukee and Milwaukee Counties; variety *horizontalis*, with extremely floriferous branches, in Outagamie, Ozaukee and Sauk Counties, a specimen from the last named county having been collected by Prof. A. B. Stout and given by him to the writer.

A. hirsuticaulis Lindl.

The plants here assigned are characterized by greatly elongated linear leaves, with entire, or nearly entire, margins, and seem sufficiently distinct from any of the foregoing to be taken out of the species *lateriflorus*. Such plants have been collected in Ozaukee and Milwaukee Counties. The writer has similar specimens from Lorain and Ashtabula Counties in northeastern Ohio.

A. missouriensis Britton

Under this name is included a group of plants with pubescent stems, oblong-lanceolate leaves narrowed at both ends, short branches and short-pediceled heads, intermediate in character between *A. lateriflorus* and *A. Tradescanti*, which do not seem to be referable to any of the varieties of *A. lateriflorus* (Milwaukee and Ozaukee Counties).

A. Tradescanti L.**A. agrostifolius** Burgess

The first of these two species has often been treated as a sort of refuge, or catch-all, in which might be gathered a number of waifs of various descriptions which could not without some degree of violence be included within the elastic limits of *A. dumosus*, *A. vimineus*, or *A. lateriflorus*, on the one hand, or of the other species of the *paniculatus* group on the other. It is treated in this way in the *Synoptical Flora* and in the sixth edition of Gray's *Manual*. In the *New Manual* it is said that "some forms approach No. 39"—*A. vimineus*—"others differ from *A. paniculatus* only in the smaller heads and shorter rays." The group here included under this name embraces a series beginning with slender plants with closely ascending branches, medium-sized heads and narrow inflorescence, followed by others of a more divaricate appearance, and ending with loosely branching forms with narrow leaves, and heads scattered at the ends of slender branchlets. The species is found in damp soil at the edges of grassy marshes, in both wooded and prairie districts from Kenosha to Outagamie and Iron counties. Extreme forms, with very narrow grasslike leaves, from Waukesha County, are referred to the species *agrostifolius* as described in the *Flora of the Southeastern United States*.

A. paniculatus Lam.**A. paniculatus** var. **simplex** (Willd.) Burgess**A. paniculatus** var. **acutidens** Burgess

This species is common in wet ground in the neighborhood of forests. Some of its forms are not easily identified with any of the varieties named in the books. The variety *simplex* has been collected in Milwaukee and Sheboygan Counties; the variety *acutidens* in Kenosha, Milwaukee and Outagamie counties. Forms with secund inflorescence are occasionally met with in Milwaukee County. Hirsute forms, suggesting relationship with *A. puniceus*, were collected by J. H. Schuette in Brown County. The rays in all cases, so far as observed, are white.

A. salicifolius Ait.**A. salicifolius** var. **subasper** (Lindl.) Gray**A. salicifolius** var. **stenophyllus** (Lindl.) Burgess

Plants assignable to this species have been collected in Outagamie, Sheboygan, Ozaukee, Milwaukee, Waukesha and Racine Counties. Prof. A. B. Stout has collected specimens in Sauk County. The variety *subasper* has been collected in Sauk, Sheboygan, Ozaukee and Milwaukee Counties; the variety *stenophyllus* in Ozaukee County. It is only rarely that the rays are other than white in the specimens collected in this state.

A. junceus Ait.

This species has been collected at the borders of tamarack swamps in Sheboygan, Waukesha and Milwaukee Counties. The rays are in most cases white, sometimes turning pink with age. Extremely delicate forms are found growing in shade, requiring support from surrounding growths.

A. longifolius Lam.

Collected by J. H. Schuette in Brown County, by Mr. Benke in Waushara and Waupaca Counties; by Mr. Finger in Monroe County; and by Dr. Ogden in the central portion of Milwaukee County. The writer's herbarium is indebted to the three last named gentlemen for specimens. Specimens collected by L. S. Cheney in Dane County are in the University herbarium. All

the specimens above referred to have violet rays. Plants intermediate between this species and *A. paniculatus* var. *simplex*, with white rays and bracts of more or less indeterminate character, have been collected in Brown County by Mr. Schuette, Door County by Dr. Ogden, Racine County by Mr. Wadmond and Dr. Ogden, in Milwaukee County by I. A. Lapham, and in Dane County by L. S. Cheney.

***A. prenanthoides* Muhl.**

Widely distributed in damp wooded districts in the eastern tier of counties, at least in the southern half of the state. It has not yet been collected farther north than Ozaukee County. It is not mentioned in Parry's or Lueders' list, or in that of Cheney and True, and it is entirely absent from Mr. Benke's and J. H. Schuette's collections. The rays are either white or light blue, differing in this respect from the deeply tinted plants of northeastern Ohio and western Connecticut. Narrow-leaved plants from the vicinity of Lake Church, in Ozaukee County, suggest the variety *porrectifolius* Porter. Stout, hispid plants from the same locality appear to be hybrids between this species and *A. puniceus*.

***A. puniceus* L.**

***A. puniceus* var. *demissus* Lindl.**

***A. puniceus* var. *compactus* Fernald**

***A. puniceus* var. *firmus* (Nees) T. & G.**

***A. puniceus* var. *lucidulus* Gray**

This species is found in marshy and swampy districts throughout the eastern portion of the state and is no doubt widely distributed. In the type form the rays are generally deeply tinted, but specimens are occasionally found in which they are pure white. In the varietal forms above mentioned the rays are white or pale in color. The variety *demissus* has been collected by Dr. Ogden, to whom the writer is indebted for a specimen, in Waushara County. Variety *compactus* is found in Sheboygan and Racine counties; var. *firmus* in Milwaukee and Waukesha counties; var. *lucidulus* in Racine, Milwaukee, Waukesha and Sauk counties. Forms occur with long, thin, entire and taper-pointed leaves, slender branches and pedicels, and with little pubescence, which connect with *A.*

longifolius and *A. paniculatus* var. *simplex*. Such forms are not uncommon in Outagamie, Sheboygan and Milwaukee counties. Similar forms, but with much more pubescence, were collected by J. H. Schuette in Brown County.

***A. umbellatus* Mill.**

***A. umbellatus* var. *pubens* Gray**

***A. umbellatus* var. *latifolius* Gray**

This species has a wide distribution in Wisconsin. Typical, narrow-leaved forms, from Dane and Vilas Counties, are contained in the Wisconsin University herbarium. The writer has similar plants from Kenosha and Milwaukee Counties. Mr. Benke has collected the variety *pubens* in Wood County. Plants from Outagamie and Kenosha counties, with short, broad leaves, are assigned to the variety *latifolius*. Many plants from Milwaukee County are characterized by leaves of unusual length and unusual breadth. Similar plants from Columbia and Lincoln Counties are in the University herbarium.

***A. linariifolius* L.**

Collected by the writer only in Sauk County, but known to have a much wider range in the state. Not found, so far as known, in the eastern tier of counties.

***A. ptarmicoides* (Nees) T. & G.**

***A. ptarmicoides* var. *lutescens* (Hook.) Gray**

The typical form of this species has been collected by the writer on the prairies of Racine County and on the rocky walls of the Wisconsin River in Columbia County; by Dr. Ogden in Waushara County; and by Mr. Benke in Wood and Waupaca Counties. There are specimens from Portage and Burnett Counties in the Milwaukee Public Museum, and one from LaFayette County in the Wisconsin University herbarium. The latter has also a specimen collected by I. A. Lapham, without date, credited to Milwaukee County, but whether from the present limits of the county cannot now be determined. The species is given in Wheeler's and Russel's lists of plants of Milwaukee County, but no specimen from this county has been preserved. It is not unlikely, however,

that it may yet be found in Milwaukee County. The variety *lutescens* occurs on the prairie between Corliss and Gatliff, and on the railroad right-of-way at Sylvania, in Racine County. A specimen in the University herbarium, from Sauk County, and others in the Milwaukee Public Museum, from Burnett and Sheboygan Counties, may belong to this variety.

A. angustus (Lindl.) T. & G.

Collected in vacant lots in the lower Third Ward in the City of Milwaukee; observed also in similar situations at Cedarburg, Ozaukee County. Mr. Wadmond has collected this species in Racine County, Mr. Benke in Manitowoc County and J. H. Schuette in Brown County.

MILWAUKEE, WIS.

January, 1, 1914.

PRICE LIST OF PUBLICATIONS

Orders and remittances should be addressed to the General Secretary, Public Museum, Milwaukee, Wis.

Numbers not included in the following list are out of print and can no longer be obtained.

Bericht des Naturhistorischen Vereins von Wisconsin, 1871, 1873, 1874, each.....	\$0.10
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The following Occasional Papers published by the Society may be had for seventy-five cents apiece:

- Vol. 1, No. 3, "Sexual Selection in Spiders of the Family Attidæ," G. W. and E. G. Peckham, 1890.
- Vol. 2, No. 1, "Ant-like Spiders of the Family Attidæ," G. W. and E. G. Peckham, 1892.
- Vol. 2, No. 2, "Spiders of the Marptusa Group of the Family Attidæ," G. W. and E. G. Peckham, November, 1894.
- Vol. 2, No. 3, "Spiders of the Homalattus Group of the Family Attidæ," G. W. and E. G. Peckham, December, 1895.
- Vol. 3, "Spiders of the Family Attidæ from Central America and Mexico," G. W. and E. G. Peckham, April, 1896.

The Wisconsin Archeologist, Vol. I, No. 1, October, 1901; Vol. I, No. 2, January, 1902; Vol. I, No. 3, April, 1902; Vol. I, No. 4, July, 1902; Vol. II, No. 1, October, 1902, each.....	\$0.25
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This publication is now issued by the Wisconsin Archeological Society of Milwaukee, from whom the later volumes may be obtained.

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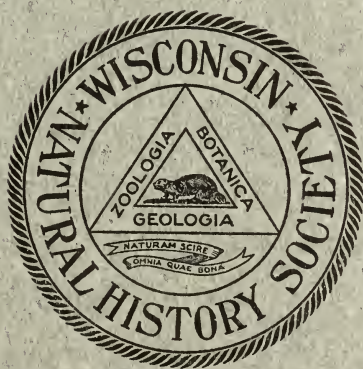
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DECEMBER, 1913

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OF THE

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P. H. DERNEHL

HOWLAND RUSSEL

EDGAR E. TELLER

The Wisconsin Natural History Society

MILWAUKEE, WISCONSIN

ORGANIZED MAY 6, 1857

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MEETINGS

Regular meetings are held on the last Thursday of each month, except July and August, in the trustees' room at the Public Museum Building, Milwaukee, and meetings of the combined sections on the second Thursday of each month, at the same place.

MEMBERSHIP DUES

Active Members, \$3.00 per annum; Junior Members, \$1.00 per annum; Corresponding Members, \$2.00 per annum; Life Members, one payment of \$50.00.

BULLETIN

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Vol. 11

DECEMBER, 1913.

No. 4

PROCEEDINGS

MILWAUKEE, WIS., April 24, 1913.

Regular meeting.

Vice-President Dernehl in the chair. Forty-nine persons present. Minutes of last meeting read and approved. The name of Henry C. Tracy, Marquette University Medical School, was presented for active membership; and was referred to the board of directors for action.

The lecture for the evening was given by Mr. A. C. Burrill, Assistant State Entomologist; the subject being "What the Community may do for Our Birds." Mr. Burrill emphasized the value of birds in helping to prevent insect plagues; and our consequent duty in the increase of bird life in Wisconsin. The annual loss due to insect pests seems to have increased in late years; at the same time the number of native insectivorous birds has decreased.

The amount of spraying has also increased. The spraying method does not seem to be very successful in permanently holding the pests in check. We must give more attention to natural checks. A number of entomologists now believe that birds are the most important of the natural checks. Birds are more a preventative, the parasite checks more effective when the plagues are established.

Wisconsin, with its central location, can hardly escape the introduction of some of the pests that are doing great damage in other states, e.g., the brown-tail moth. Therefore, the best precaution, in addition to having rigid inspection laws, is to increase the bird population.

The proper protection of birds depends upon public sentiment. Public sentiment can best be aroused by creating a greater love of nature. We are at the beginning of what might be called an age of bird conservation.

Community coöperation: Bird protection laws are not sufficient. We must wage active warfare against bird enemies such as the English sparrows and the cats. The number of English sparrows has increased to nearly 40 per cent of the total bird population. This sparrow does great damage to the native birds, and is not half as effective in the destruction of insects as the birds it displaces. The cat, especially the tramp cat, is one of the

birds' worst enemies, as it catches on the average fifty birds a year. We need bird sanctuaries about the cities. Now is the time to set aside good marsh and water havens, before all the marsh and swamp lands are drained.

Individual work: The amount of damage done to fruit trees by birds is more than compensated by the number of insects eaten. Orchardists should plant wild fruits that mature at the same time, or a few days earlier than the cultivated fruits; e.g., plant mulberries and wild cherries in the vicinity of the cultivated cherry trees, for the benefit of the robins. The feeding of birds in winter is not always to be favored; the birds, under such conditions, are not so likely to forage for insect food. More bird boxes should be supplied for nesting. Perhaps the making of these boxes could be made a part of the manual training work in the schools.

Mr. Burrill described the foods and the feeding habits of a number of birds, and suggested means of encouraging the nesting of each species about dwellings. The bob-white is very valuable to the farmer; it should be removed from the list of game birds and be put in the list of protected birds.

At the conclusion of the lecture, Professor Mitchell remarked that he was, to some extent, the friend of the sap-sucker, because it is possible that this bird causes the variety of maple wood known as "bird's-eye." He said that the increase of the number of bird boxes about dwellings was good, provided that the boxes be watched closely, to prevent attacks and occupation by English sparrows.

Mr. Russel spoke on the enforcement of game laws. He emphasized the need of such organizations as the Wisconsin Fish and Game Protective and Propagation League, and commended, in this connection, the work of Mr. Burrill.

On motion, a vote of thanks was extended to Mr. Burrill for his most interesting and timely lecture.

Mr. Ward remarked on the McLean bill for the protection of migratory birds, and spoke of a new clause that has been inserted in the present tariff bill. This clause was recommended by the New York Zoölogical Society, and reads as follows: "Provided, that the importation of aigrettes, egret plumes or 'osprey' plumes, and the feathers, quills, heads, wings, tails, skins or parts of skins, of wild birds, either raw or manufactured, and not for scientific or educational purposes, is hereby prohibited; but this provision shall not apply to the feathers or plumes of ostriches, or to the feathers of domestic fowls of any kind."

On motion of Mr. Ward, the secretary was instructed to inform the Wisconsin congressmen that the society strongly endorses this provision, and wishes its retention in the tariff bill.

Professor Mitchell emphasized the need of better federal inspection laws for the control of insect pests.

The meeting then adjourned.



GEORGE WILLIAMS PECKHAM, M.D., LL.D.
1845-1914

GEORGE WILLIAMS PECKHAM, M.D., LL.D.
1845-1914

Dr. George Williams Peckham died suddenly on January 10, 1914, at his home in Milwaukee, of heart failure, the outcome of a malady from which he had suffered for some years. He was 68 years old.

His great interest in, and the part he took in building up, the Wisconsin Natural History Society call for more than a passing notice of his death. He became a member of the Society in 1876, was elected its president in 1884 and held this office until 1900, when he insisted that another take his place. It was during this period that the collections and the library of the Society were donated to the city, on condition that they be suitably housed, maintained and increased. It was largely as the result of his efforts that the present public library and museum was built and so generously provided with financial support that it has become that feature of the city of which our people are probably the most proud. Until his health began to fail, Dr. Peckham took an active part in the meetings of the Society and the majority of his papers were published in its bulletins. At all times he exerted his influence to promote scientific study and personal research, to elevate the standing of the Society, and to increase its prestige in the opinion of the community. He was also a member of the Wisconsin Academy of Sciences, Arts and Letters, in whose proceedings some of his papers were published.

Dr. Peckham's earnest love of science is well shown by the fact that all of his work in this line was done during his vacations and in the little leisure time left him by the pressing duties of the offices he held. His standing in the scientific world was such that he counted among his friends and correspondents many of the most eminent scientists of the day; it was due to this eminence that the honorary degree of LL.D. was conferred upon him by the University of Wisconsin.

Though he was greatly interested in and well informed on almost

every branch of science, his principal study was of spiders and insects, and his writings were on this subject. He was an international authority on spiders. Collections were sent to him for identification or description by students of this order in all parts of the world and hundreds of species were first described and named by him. The study of birds, and bird life also, had always had a great attraction for him, and at the time of his death he was studying the coloration of the birds of the West Indies in the hope of suggesting a lucid explanation of the peculiar variations observed there.

He was a man of great force and of strong individuality and was possessed of a characteristic charm of manner which brought him numberless friends.

Dr. Peckham was the son of Geo. Williams Peckham and Mary Perry Peckham and was born at Albany, New York, on March 23, 1845. He came to Milwaukee when nine years old. Shortly after the outbreak of the Civil War he joined the Union Army and rose from the ranks to first lieutenant while still under age. About the time of the close of the war he became a student at Antioch College, in Ohio, and later at Ann Arbor, Michigan, where he received the degree of M.D. He studied law at Albany Law School and was admitted to practice in Wisconsin. He became instructor of biology in the Milwaukee East Side High School in 1870 and later its principal, remaining at this school till 1892. He then resigned this position to become Superintendent of Public Instruction which office he held until 1896, when he was made Librarian of the Milwaukee Public Library. In 1910 his health became such that he gave up this office and ceased all active work, devoting such time as he could to his favorite studies.

In 1880 he married Elizabeth Gifford, now living. There are three children: Mrs. Mary Gifford Gross; Geo. Williams Peckham, now assistant Professor of Philosophy at Columbia University; and Harold Gifford Peckham. Dr. Peckham was particularly happy in his married life, as his wife took the greatest interest in his work, coöperated with him in his scientific studies and observations and took an equal part in the preparation of the many papers published under their joint name.

The following is a list of the papers published by Dr. Geo. W. Peckham and Eliz. G. Peckham:

1882. Temperatures of Pine, Beaver and Okauchee Lakes. Trans. Wis. Acad. Sci., Arts and Letters, vol. 5, pp. 273-275, 1 pl. Madison.
1883. Descriptions of New or Little Known Spiders of the Family *Attidae*, from Various Parts of the United States of North America. 35 pp., 3 pls. Milwaukee.
1885. On the Genera of the Family *Attidae*. Trans. Wis. Acad. Sci., Arts and Letters, pp. 257-342. Madison.
1885. On Some Genera and Species of *Attidae* from the Eastern Part of Guatemala. Proc. Wis. Nat. Hist. Soc., pp. 62-86. Milwaukee.
1885. On Some New Genera and Species of the Family *Attidae* from Madagascar and Central America. Proc. Wis. Nat. Hist. Soc., pp. 23-42, 1 pl. Milwaukee.
1887. Some Observations on the Special Senses of Wasps. Proc. Wis. Nat. Hist. Soc., pp. 91-132. Milwaukee.
1887. Some Observations on the Mental Powers of Spiders. Journal of Morphology, 1, no. 2, pp. 383-419. Boston.
1887. On Duration of Memory in Wasps. American Naturalist, vol. 21, pp. 1038-1040. Philadelphia.
1888. North American Spiders of the Family *Attidae*. Trans. Wis. Acad. Sci., Arts and Letters, pp. 1-104. Madison.
1888. Spiders of the Subfamily *Lysomanae*. In Collaboration with William Morton Wheeler. Trans. Wis. Acad. Sci., Arts and Letters, pp. 222-256, pls. 11 and 12. Madison.
1889. Observations on Sexual Selection in Spiders of the Family *Attidae*, pp. 1-60; Protective resemblance in Spiders, pp. 61-113. Proc. Wis. Nat. Hist. Soc. Milwaukee.
1891. Additional Observations on Sexual Selection in Spiders of the Family *Attidae*, with Some Remarks on Mr. Wallace's Theory of Sexual Ornamentation. Proc. Wis. Nat. Hist. Soc., pp. 117-151.
1892. Ant-like Spiders of the Family *Attidae*. Occasional Papers, Wis. Nat. Hist. Soc., vol. 2, no. 1, pp. 1-83, pls. 1-6. Milwaukee.
1893. Spiders of the Family *Attidae* of the Island of St. Vincent. Proc. Zool. Soc., London, pp. 692-697, 2 pls. London.
1894. Spiders of the *Marptusa* Group of the Family *Attidae*. Occasional Papers, Wis. Nat. Hist. Soc., vol. 2, no. 2, pp. 85-156. Milwaukee.
1894. New Trinidad Spiders of the Family *Attidae*. Trinidad Field Club, vol. 2, pp. 212-216. Trinidad.
1895. The Sense of Sight in Spiders with Some Observations on the Color Sense. Trans. Wis. Acad. Sci., Arts and Letters, vol. 10, pp. 231-261. Madison.
1895. Notes on the Habits of *Trypoxylon rubrocinctum* and *Trypoxylon albopilosum*, Psyche, pp. 303-306. Cambridge, Mass.
1895. Spiders of the *Homolattus* Group of the Family *Attidae*. Occasional Papers, Wis. Nat. Hist. Soc., vol. 2, no. 3, pp. 159-183. Milwaukee.
1896. Spiders of the Family *Attidae* from Central America and Mexico. Occasional Papers, Wis. Nat. Hist. Soc., vol. 3, no. 1, pp. 1-101, pls. 1-7. Milwaukee.

1898. On the Instincts and Habits of the Solitary Wasps. Bull. no. 2, Wis. Geol. and Nat. Hist. Survey, pp. 4 and 245, 14 pls. Madison.
1900. Additional Observations on the Instincts and Habits of the Solitary Wasps. Bull. Wis. Nat. Hist. Soc., vol. 1 (new series), pp. 85-93.
1900. Instinct or Reason? American Naturalist, vol. 34, pp. 817-818. Philadelphia.
1900. *Pellenes* and Some Other Genera of the Family *Attidae*. Bull. Wis. Nat. Hist. Soc., 1 (2), pp. 195-233, pls. 1 and 2. Milwaukee.
1901. Spiders of the *Phidippus* Group of the Family *Attidae*. Trans. Wis. Acad. Sci., Arts and Letters, vol. 13, pp. 282-346, pls. 23-28. Madison.
1901. On Spiders of the Family *Attidae* Found in Jamaica, communicated by R. I. Pocock. Proc. Zool. Soc., London, 1900 (2), pp. 6-16, pls. 2-4. London.
1902. Some New Genera and Species of *Attidae* from South Africa. Psyche, vol. 9, pp. 331-335. Cambridge, Mass.
1903. New Species of the Family *Attidae* from South Africa, with Notes on the Distribution of the Genera found in the Ethiopian Region. Trans. Wis. Acad. Sci., Arts and Letters, vol. 14, pp. 173-278, pls. 19-29. Madison.
1905. Wasps, Social and Solitary. Pp. 14 and 310, 53 Illustrations. Houghton, Mifflin and Company. Cambridge, Mass.
1907. The *Attidae* of Borneo. Trans. Wis. Acad. Sci., Arts and Letters, vol. 15, pp. 603-653. Madison.
1909. Revision of the *Attidae* of North America. Trans. Wis. Acad. Sci., Arts and Letters, vol. 16, pp. 355-646, 22 pls., 3 figs. Madison.

Educational Papers by George Williams Peckham

1882. The Growth of Children. Ann. Rep. State Board of Health, pp. 1-46. Madison.
1882. Various Observations on Growth. Ann. Rep. State Board of Health, Wisconsin, vol. 7, pp. 185-188. Madison.
1894. The Public Library and the Public Schools. Educational Review, November, 1894, pp. 358-362.
1904. Libraries and Schools. Milwaukee. Meyer-Rotier Printing Company.

*Howland Russel,
S. Graenicher,
Edgar E. Teller.*

THE BIRDS OF WAUKESHA COUNTY, WISCONSIN

BY ALVIN R. CAHN

INTRODUCTION

Since the publication of Kumlien and Hollister's "Birds of Wisconsin,"¹ there have been, as far as the writer is aware, no published lists of Wisconsin birds. This book, dealing with the entire state, brings the bird work up to 1903 so far as a general list is concerned, and includes 357 species. The following paper is based largely on the writer's own work in Waukesha County begun in 1907, and is offered as a list of the birds known definitely to occur in that county, with brief notes as to occurrence, abundance, and like points of interest. The list contains 194 species known to the county, and a hypothetical list of eight species.

Waukesha County is located in what may be termed the second tier of southern counties, and lies with its eastern border some twenty miles from Lake Michigan, Milwaukee County intervening. This places it within the area influenced by that lake, yet well beyond the range of many of the species of ducks, gulls and shore birds common to that region. Its avifauna is predominantly that of the Alleghanian faunal area of the Transition Zone.²

Owing to its diversity, the county offers a field of exceeding interest to the ornithologist. Large swampy areas, many small creeks, and several somewhat larger river systems afford excellent breeding ground for numerous species of marsh and swamp inhabiting birds, while more than fifty lakes of various sizes attract the many shore and water birds. The wood-lots are small and scattered, but there still remain some good, fairly thick woods where in one may find an occasional partridge.

Topographically, the county may be divided into three parts. The entire eastern half comprises the area of gently rolling hills

¹ *Bull. Wis. Nat. Hist. Soc.*, vol. 3, nos. 1, 2, 3, January-July 1903.

² C. Hart Merriam, "Life Zones and Crop Zones of the U. S." *Bull. 10, Biol. Survey, U. S. Dept. Agr.*, 1898.

and small, scattered, nearly dry marshes, and a few small streams which are tributary to the Fox River—the principal water-course in this section. This area contains but three lakes, which lie in the extreme southeastern corner. The western section may be divided into a northern and a southern half: the southern may be characterized by rough, broken hills or kames, while the northern part is generally known as the “lake region,” and is of the greatest ornithological interest.

The lake region proper is approximately 105 square miles in extent, and contains thirty-five lakes, the largest of which is Pewaukee, with an area of 3.61 square miles.³ The lakes are for the most part arranged in chains, there being but few isolated lakes of any size. The land surrounding them is low, and in the case of many of the smaller ones, marshy and treeless. It is here among the shore rushes that the grebes, coots and bitterns breed, while in the swamps surrounding the lakes rails, marsh wrens and redwings are to be found in abundance. Three river courses flow through this area, all in a southwesterly direction. The Ashippun River, the smallest and most northerly of these, serves both as an inlet and outlet of the Ashippun Lake—a most interesting breeding ground for many species of birds. The Oconomowoc River is of perhaps the most importance, as it connects four of the largest lakes in the county, and is navigable for small launches between Oconomowoc and Fowler Lakes. The river is admirable for the many species of sandpipers, and individuals of one species or another are to be found there at almost any time during the spring, summer and fall. Bark River is the southernmost of these systems, and near Utica is joined by Scuppernong Creek, a little stream flowing through very wet, swampy, and interesting land. These three systems all enter Rock River in Jefferson County. Near the southern limit of this lake area are found several large swamps, notably one near Golden Lake. These swamps are, at some seasons, extremely wet and almost impassable. They are characterized by the common marsh grass (*Spartina* sp?), with many dense tamarack covered “islands,” and are the breeding and hunting ground of many raptorial birds. In direct contrast with these lowlands, the highest point in the county, Government Hill,

³ N. M. Fenneman, “Lakes of Southeastern Wisconsin.” *Bull. VIII Wis. Geol. and Nat. Hist. Survey*, 1902.





having an elevation of 1233 feet, is located in this lake region. The principal topographic features of this lake area are shown on the map accompanying this paper. With such great variation in the character of the country it is not surprising that Waukesha County should have a rich avifauna.

The writer wishes to express his indebtedness to Dr. F. C. Rogers, Mr. Henry Turnow and Mr. E. W. Tuttle of Oconomowoc for notes on several species of birds; to the Wisconsin Fish and Game Warden Department for information on many ducks, obtained from two of its wardens, Mr. Schlueter and Mr. Raeth, and to Dr. A. S. Pearse of the University of Wisconsin for many helpful suggestions.

With these prefatory remarks the list of birds of Waukesha County is presented as follows:

LIST OF BIRDS OF WAUKESHA COUNTY, WISCONSIN

Colymbus holboelli (Reinhardt). HOLBOELL'S GREBE

Not an uncommon migrant. Dr. F. C. Rogers reports seven or eight individuals from near the west end of Oconomowoc Lake on April 28, 1912, and in other years they have been seen on Wash Tub Lake as well.

Colymbus auritus Linnaeus. HORNED GREBE

A rather uncommon migrant, more plentiful in the fall than in the spring. Frequents the larger lakes, and is for the most part solitary.

Podilymbus podiceps (Linnaeus). PIED-BILLED GREBE

A common summer resident throughout the county. At the approach of fall the birds congregate in small flocks in practically all of the lakes where there is a rushy shore for their protection. A nest with five nearly fresh eggs was found in Wash Tub Lake on June 23, 1913.

Gavia immer (Brünnich). LOON

A regular migrant, and occasionally a summer resident. A female was seen on Golden Lake on June 10, 1913, and on several occasions thereafter, but there is no evidence of nesting. A male was shot on Oconomowoc Lake late in October, 1912.

Larus marinus Linnaeus. GREAT BLACK-BACKED GULL

A rare migrant, seen most frequently about Golden Lake, from which region Mr. C. A. Koch reports having caught one with an injured wing a few years ago. The birds are for the most part solitary, and rarely more than two individuals are seen together.

Larus argentatus Pontoppidan. HERRING GULL

A common resident, seen sparingly during the summer and winter months, but more commonly in the spring and fall. Several immature birds were seen during the entire summer of 1912 in the vicinity of Pewaukee Lake.

Larus delawarensis Ord. RING-BILLED GULL

A regular migrant, though occasionally seen during the summer. More abundant than is generally believed.

Larus philadelphia (Ord). BONAPARTE'S GULL

A regular, though hardly an abundant spring and fall migrant, usually arriving in very large flocks. One mature and one immature individual were seen on Dutchman's Lake on August 28, 1912.

Sterna hirundo Linnaeus. COMMON TERN

An abundant spring and fall migrant. The fall migration begins about the middle of August, and after the first of September the birds may be seen over almost any of the larger lakes. Usually in flocks of eight to fifteen.

Hydrochelidon nigra surinamensis (Gmelin). BLACK TERN

A common summer resident on certain lakes only. About ten pairs nest yearly in the rushes at the north end of Golden Lake, where they may be seen until well into September. The colony, although undisturbed, does not show appreciable increase in numbers. This is a very gentle bird, which will follow a fishing boat for hours, picking up every dead minnow available. Black plumaged birds are rare after the middle of August, although one was seen August 27, 1913.

Mergus americanus Cassin. MERGANSER

A common early spring and late fall migrant, rarely seen after April or before November. The commonest of the "fish-ducks" during the early part of April.

Mergus serrator Linnaeus. RED-BREASTED MERGANSER

A regular migrant on the larger lakes. Found usually in larger flocks than the preceding, but the flocks are fewer in number. Arrives in the spring about the same time as *Mergus americanus*, but leaves earlier in the fall.

Lophodytes cucullatus (Linnaeus). HOODED MERGANSER

A common migrant, coming somewhat later than the preceding species. None of the Mergansers nest within the county.

Anas platyrhynchos Linnaeus. MALLARD

A common migrant and winter resident, and regular, though not a common, summer resident and breeding species. Several pair nest annually in the "dead river" area of the Oconomowoc River, and in the wet marshes about Ashippun Lake. These are, however, promptly exterminated on the first day of the hunting season.

Anas rubripes Brewster. BLACK DUCK

A common migrant and often a winter resident. During the winter they may sometimes be found in the grain fields several miles from open water. Apparently far less abundant than formerly, although one of our most timid ducks.

Mareca americana (Gmelin). BALDPATE

A common migrant, more common in the spring than in the fall, and usually on the larger lakes. Found generally in small flocks or pairs, associated with other ducks, often with the Lesser Scaup and Ring-neck.

Nettion carolinense (Gmelin). GREEN-WINGED TEAL

A common migrant during late March and April. One of the common ducks of the region, although steadily decreasing in abundance.

Querquedula discors (Linnaeus). BLUE-WINGED TEAL

A regular and common migrant, far more abundant than the preceding species. Steadily decreasing in numbers, and is at present more uncommon than a few years ago. Arrives about the second week in April, and may be seen until well into May. The fall migration begins early—about the last of September, and is of very short duration.

***Spatula clypeata* (Linnaeus). SHOVELLER**

A common migrant during late March and April, more abundant, however, during the fall migration—through October and November. There are several reports of nesting "Spoonbills," all unconfirmed. A pair was seen on Nagawicka Lake on June 3, 1911, and a lone female on Golden Lake on June 5, 1913. Usually found in small flocks of three to six or eight individuals during the migrations, and not commonly associated with other species of ducks.

***Dafila acuta* (Linnaeus). PINTAIL**

Still an abundant migrant, though steadily decreasing with the other ducks. One of the early ducks to arrive on both migrations. The spring migration begins in March and lasts through April. In the fall the great majority have passed south by the second week in October.

***Aix sponsa* (Linnaeus). WOOD DUCK**

A common migrant during early April and through September and early October. These birds have suffered the greatest injury at the hands of the hunters of all our game birds. Formerly one of the most abundant of our ducks, now barely a common species. Owing to the early fall migration, the Wood Duck arrives about the time the hunting season opens, and great numbers are killed in the enthusiasm of the early part of the season. All through the last half of September the hunters bring in their limit bag of fifteen ducks, upward of twelve of which are apt to be Wood Ducks. The state has at last undertaken the protection of these birds, and it is to be hoped that their decrease may be checked. No doubt nested in this region formerly, but no authentic records are at hand for the county in the past few years. In 1912 a pair was seen during the early part of June near the north end of Golden Lake, but the nest was never found, and if it existed it was undoubtedly in Jefferson County.

***Marila americana* (Eyton). REDHEAD**

A regular migrant, which can hardly be said to be even common at present. Most plentiful, however, during the fall migration, through late October and November, but usually only the larger lakes, as Pewaukee, Okauchee and Oconomowoc. Greatly decreased in numbers during the last few years, and still steadily

decreasing. Formerly bred at Pewaukee Lake, according to Kumlien and Hollister,⁴ but this was many years ago, and it is very doubtful indeed if at present any breed within the county limits.

Marila valisineria (Wilson). CANVAS-BACK

A common migrant, which seems just now almost, if not quite, to be holding its own against the hunters, although of course greatly decreased in numbers as compared with the flocks of former days. More common than the Redheads, with which migrant they may sometimes be found associated. Most common during the fall migration, particularly during November, when comparatively large flocks, often as many as fifty or more may be found.

Marila marila (Linnaeus). SCAUP DUCK

An uncommon migrant, though probably more common than the data at hand signify. A hunter was seen at Oconomowoc on October 20, 1913, with five good specimens of this species, shot on Nagawicka Lake. Outside of three other specimens seen by the writer, data are lacking, as hunters do not distinguish between this species and the next, the common Bluebill.

Marila affinis (Eyton). LESSER SCAUP

By all odds the most abundant of our ducks. Arriving about the middle of October, these ducks are abundant until driven south by the closing of the lakes. During early November, 1913, hundreds of "Bluebills" were killed on Okauchee Lake alone. Yet, despite the great slaughter they undergo, they return year after year in apparently undiminished numbers. May be found on any of the lakes irrespective of size, and very often small flocks or lone individuals occur on the rivers and creeks.

Marila collaris (Donovan). RING-NECK DUCK

A common migrant, found most often associated with the flocks of Lesser Scaup ducks, in which they mingle. More common, however, on the larger lakes, and rare on the rivers.

Clangula clangula americana Bonaparte. AMERICAN GOLDEN-EYE

A common migrant, more abundant during the fall migration than in the spring. One of the last ducks to arrive, remaining

⁴ *Birds of Wisconsin*, p. 21.

often until the last lake is frozen over. In 1912 Oconomowoc Lake did not close until the very end of December, and a flock of eight Golden-Eyes was reported on December 26, the latest record at hand. The spring migration occurs early, and few are seen after the second week in April.

Charitonetta albeola (Linnaeus). BUFFLE-HEAD

A common migrant, often more plentiful in the spring than in the fall. Not found in large flocks, but a few individuals are often found associated with larger flocks of Canvas-Backs or Mallards. There is a single breeding record for Pewaukee Lake, the only Wisconsin record,⁵ but this is of course exceptional, and it cannot be classed at present as a breeding species.

Harelda hyemalis (Linnaeus). OLD SQUAW

A rare migrant, and only on the larger lakes. A flock of twelve was seen on Oconomowoc Lake on March 27-28, 1912, the only definite record during the last few years.

Erismatura jamaicensis (Gmelin). RUDDY DUCK

A common migrant, steadily decreasing.⁶ Arrives about the middle of April, and is more common on the fall migration during late October and November. At the present time a very doubtful breeding species, though undoubtedly more common in this capacity formerly. Commonly called the "Bull-necked Teal," and not highly thought of as a "food" bird.

Branta canadensis canadensis (Linnaeus). CANADA GOOSE

A common migrant and often a winter resident in suitable localities. The fall migration varies greatly, and flocks often do not become common until well into November. On October 25, 1913, a flock numbering over five hundred flew low over Oconomowoc Lake, apparently with the idea of lighting, but an ill-timed gun shot spoiled what promised to be a beautiful sight. Steadily increasing in numbers. But very few are killed each year in Waukesha County, due no doubt to the birds' great timidity.

Olor columbianus (Ord). WHISTLING SWAN

A rare migrant on the larger lakes of the county. Early in April, 1910, the exact date being unobtainable from the individuals re-

⁵ Kumlien and Hollister, *Birds of Wisconsin*, p. 25.

⁶ Kumlien and Hollister, *Birds of Wisconsin*, p. 27.

porting the birds, a flock of eight was seen on Pewaukee Lake, where it remained for several hours. Flocks have also been reported from Nagawicka and Okauchee Lakes.

***Botaurus lentiginosus* (Montagu). BITTERN**

A common summer resident about the less frequented and wilder lakes and marsh-lined river courses. A deserted nest was found on June 23, 1913, in the tall grass about Wash Tub Lake, and the adult birds with three young were flushed within one hundred feet of the nest.

***Ixobrychus exilis* (Gmelin). LEAST BITTERN**

A common summer resident in all suitable locations. Small and retiring, they are but little in evidence. Four nests were found at Wash Tub Lake, June 23, 1913, three containing five very young birds, and one three eggs well advanced in incubation.⁷ Far more common than present records would tend to indicate.

***Ardea herodias herodias* Linnaeus. GREAT BLUE HERON**

A regular spring and fall migrant and rarely a summer resident. A single pair attempted to nest in a swamp east of Oconomowoc early in the summer of 1909, but thanks to a party of small boys, the egg-laying was never completed, and one of the birds was killed. This is, so far as is known, the only recent attempt at breeding within the county.

***Butorides virescens virescens* (Linnaeus). GREEN HERON**

A common summer resident, found throughout the county, along the water courses. Nests sparingly in suitable places, as the woody shores of Dutchman's, Nagawicka and Golden Lakes. Feeds largely on frogs, for which it will travel long distances to marshes.

***Nycticorax nycticorax naevius* (Boddaert). BLACK-CROWNED NIGHT HERON**

An occasional summer resident, though but rarely seen. Two young were seen in the swamp of the Oconomowoc River, and one of these was secured. This was on August 8, 1912, and an adult was seen in the same location on September 12, 1913. No doubt breeds within the county, but there is no herony, and no nests are recorded.

⁷ Kumlien and Hollister, *Birds of Wisconsin*, p. 34.

***Grus mexicana* (Müller). SANDHILL CRANE**

A rare migrant, found only in undisturbed localities. In 1910 a single pair was noted near Dutchman's Lake, and Dr. F. C. Rogers reports them for June 6, 1912. The bird commonly called "crane" in this locality is the Great Blue Heron.

***Rallus elegans* Audubon. KING RAIL**

A rather uncommon summer resident in most parts of the county, but a breeding species where found. A beautiful male was seen on the shore of Otis Lake on September 18, 1913, where it was feeding upon shore insects. Extremely timid, and is more often heard than seen.

***Rallus virginianus* Linnaeus. VIRGINIA RAIL**

An abundant breeding species throughout the swampy region of the county. Owing to their seclusive habits, the birds are not often seen. An immature specimen was killed by an automobile near the outlet of Oconomowoc Lake, while crossing the road from one swamp to another. Nests in almost any swampy area, often among the rushes of the lake shore.

***Porzana carolina* (Linnaeus). SORA**

An abundant breeding species, found nesting in nearly every swamp or wet region. Two nests, each with twelve eggs, were located in a patch of rushes not over 75 feet square, near the outlet of Oconomowoc Lake, on June 4, 1913, both within 20 feet of the most traversed roadway in the state. This same area contained one nest of *Rallus virginianus* and three of the Red-winged Black-bird. The commonest of our rails.

***Gallinula galeata* (Lichtenstein). FLORIDA GALLINULE**

An occasional summer resident, breeding where found. A pair nested at Dutchman's Lake in 1912. Although the nest was not found, the young were commonly in evidence during the summer.

***Fulica americana* Gmelin. COOT**

The "Mud-hen" of the hunters. A common spring and abundant fall migrant. Arriving about September 20, they are found on all the lakes until late in the fall in greater or less abundance. Such lakes as Wash Tub, Silver, Golden, Otis and Duck afford

excellent shelter for the species, but their ranks are very quickly thinned when the hunters discover them. The species breeds sparingly about the wilder lakes.

***Steganopus tricolor* Vieillot. WILSON'S PHALAROPE**

Kumlien and Hollister state that "breeding colonies are found near Pewaukee,"⁸ but the bird certainly is uncommon in this region at present. During 1913 but two males are recorded from Pine Lake.

***Philohela minor* (Gmelin). WOODCOCK**

Practically exterminated in this region, though an occasional bird may still be flushed in the less populated localities. Once an abundant game bird, but now really rare. The hunters of the county tell marvelous tales of the abundance of the woodcock in former years, and admit that it has been reduced in numbers perhaps more than any other game bird. On September 16, 1913, the writer flushed a bird from the swampy area about the outlet of Oconomowoc Lake.

***Gallinago delicata* (Ord). WILSON'S SNIPE**

A not uncommon summer resident. During late May, June and early July a pair was often seen near the outlet of Oconomowoc Lake, where they no doubt nested. A nest of the "big jack snipe" is reported from this region in 1911, and is undoubtedly correct. Three specimens were flushed along the Oconomowoc River, near Oconomowoc Lake, on September 15, 1913. Not noticeably decreasing in abundance.

***Pisobia maculata* (Vieillot). PECTORAL SANDPIPER**

A rather uncommon migrant, found perhaps more commonly during the fall migration. A single specimen was seen along the Oconomowoc River on June 1, 1913, and another on September 11, 1913.

***Pisobia minutilla* (Vieillot). LEAST SANDPIPER**

A regular migrant, though not common. Two specimens were recorded on May 30, 1913, from the "dead river" area of the Oconomowoc River.

⁸ Kumlien and Hollister, *Birds of Wisconsin*, p. 24.

***Pelidna alpina sakhalina* (Vieillot). RED-BACKED SANDPIPER**

An irregular and uncommon migrant, seen most often in the spring about the middle of May, and but rarely in the fall. Is found only in the extreme western position of the county, usually along the Oconomowoc River, in small flocks of eight to ten birds. A lone individual was seen on the shore of Oconomowoc Lake on September 10, 1912.

***Ereunetes pusillus* (Linnaeus). SEMIPALMATED SANDPIPER**

A common migrant and rarely a summer resident. It arrives during the first week in May, and returns southward about the first of September. Several were seen about Silver Lake during July, 1912, but there is no evidence of breeding.

***Totanus melanoleucus* (Gmelin). GREATER YELLOW-LEGS**

A regular migrant, although not common. Arrives about the end of the first week, in April, and is seldom seen after the third week of that month. According to the hunters of the region formerly far more abundant than at present, and evidently steadily decreasing.

***Totanus flavipes* (Gmelin). YELLOW-LEGS**

A common migrant. A flock of eight remained near Pewaukee Lake from September 12 to 17, at which time five were "bagged." An exceedingly wary bird, and one difficult to approach.

***Helodromas solitarius solitarius* (Wilson). SOLITARY SANDPIPER**

A common summer resident, found along the lake shores, but more especially along the Oconomowoc and Ashippun Rivers. Is apparently rather erratic, being almost abundant some years, and decidedly uncommon others. Such was the case in 1911 and 1912, when the birds were to be seen at almost any time along these rivers, and in 1913, when but surprisingly few were seen. Is all too frequently shot by the "sportsman."

***Bartramia longicuada* (Bechstein). BARTRAMIAN SANDPIPER**

A regular migrant, though hardly a common one. On September 4, 1911, a single specimen was taken on the shore of Silver Lake, and two individuals were taken in the same locality on September 11, 1912.

Actitis macularia (Linnaeus). SPOTTED SANDPIPER

A common summer resident, and often, though probably not always, a breeding species. Found along all water-fronts until about the middle of October. Makes an apparently irresistible mark for the ambushed duck hunter, and therefore many are killed uselessly each year.

Oxyechus vociferus (Linnaeus). KILLDEER

A very common summer resident and breeding species. A nest with the customary four eggs, which hatched June 19, 1913, was found in a cornfield a quarter of a mile from the Oconomowoc River. A good series of photographs of the sitting bird was obtained from this nest. No attempt was made to conceal the camera, and the birds showed their utter fearlessness toward it by actually alighting upon the box time and again while returning to the nest. Found commonly in flocks of as many as twenty or more during the early part of September, and become extremely wary as soon as the shooting season begins.

Aegialitis semipalmata (Bonaparte). SEMIPALMATED PLOVER

An occasional summer resident, though far more common as a migrant.

Colinus virginianus virginianus (Linnaeus). BOB-WHITE

A rather uncommon resident, more often seen than heard. A flock of fourteen was flushed from the tall grass near the outlet of Oconomowoc Lake, and a single bird was heard continually during the early part of June, 1913. On June 22, 1913, a flock of five was watched for fully half an hour, as they fed among the weeds within 50 feet of the observer. Undoubtedly on the increase.

Bonasa umbellus umbellus (Linnaeus). RUFFED GROUSE

Practically exterminated from most of the county, though an occasional bird may still be flushed in some unfrequented woods, as those around Dutchman's Lake.

Tympanuchus americanus americanus (Reichenbach).

PRAIRIE CHICKEN

The "prairie chicken," like the ruffed grouse, is practically gone, but occasional individuals may still be found in the more secluded

parts of the county, and even, as on one occasion, within the city limits of Oconomowoc.

***Zenaidura macroura carolinensis* (Linnaeus). MOURNING DOVE**

A common summer resident, nesting abundantly throughout the region. During June, 1913, seven nests were under observation, from which not a single young bird was raised, on account of unusually high winds and red squirrels. Quite contrary to the usual habit of the species, not one of these nests was below 8 feet from the ground, while the two highest were in the upper branches of elm trees (*Ulmus americana*), at an elevation of 31 and 39 feet.

***Circus hudsonius* (Linnaeus). MARSH HAWK**

A common summer resident and nesting species in the larger swamp areas. Found continually along the Oconomowoc and Ashippun Rivers, and over the swamps near Dutchman's Lake. Because of its low-flying habit and large size this hawk is shot at continually, and many are killed every year.

***Accipiter velox* (Wilson). SHARP-SHINNED HAWK**

A common migrant, arriving early in April. Has been found to feed upon robin, bluebird, fox and white-throated sparrows, towhee and junco.

***Accipiter cooperi* (Bonaparte). COOPER'S HAWK**

A common migrant and summer resident. One of the most, if not the most destructive hawk in this region, taking a steady toll of all available poultry and song birds. In 1912 a pair nested in a tamarack swamp near Golden Lake.

***Buteo borealis borealis* (Gmelin). RED-TAILED HAWK**

A common migrant and occasional summer resident and breeding species, though at no time numerous. Like many of the larger and for the most part beneficial hawks, the red-tailed hawk is constantly prosecuted, while the smaller hawks, as Cooper's and the sharp-shinned, are allowed to pass unnoticed.

***Buteo lineatus lineatus* (Gmelin). RED-SHOULDERED HAWK**

A not uncommon migrant, for which, however, there are but few records. Much more uncommon than is the red-tailed hawk.

Buteo platypterus (Vieillot). BROAD-WINGED HAWK

A common migrant found often early in April. Apparently a perfectly harmless hawk, which, in this region, feeds largely upon frogs and field mice (*Microtus pennsylvanicus*).

Archibuteo lagopus sancti-johannis (Gmelin). ROUGH-LEGGED HAWK

A regular migrant and occasionally a winter resident, and never a very common species. Three were seen over Oconomowoc Lake on April 16, 1911, and one late in September, 1912.

Haliaeetus leucocephalus leucocephalus (Linnaeus). BALD EAGLE

A single immature individual seen in a dead tree near Dutchman's Lake on September 8, 1912, is the only record during the last few years for this bird. This individual was not timid, and was closely observed by five persons.

Falco columbarius columbarius Linnaeus. PIGEON HAWK

A common migrant, arriving early in April.

Falco sparverius sparverius Linnaeus. SPARROW HAWK

A summer resident, though not a very common one. A pair nested in 1912 near Pine Lake, but the nest was robbed before the young hatched. Several nests were found near Golden Lake in 1913.

Pandion haliaetus carolinensis (Gmelin). OSPREY

An occasional visitor within the county during the summer, but not resident so far as is known. On August 16, 1912, a pair fished along the north shore of Oconomowoc Lake, feeding on the small fish found just beneath the surface of the water.

Asio wilsonianus (Lesson). LONG-EARED OWL

A common resident and breeding species in many of the wilder regions. In 1912 a pair bred in the thick swamp area at the south side of Dutchman's Lake, and another pair nested just north of Ashippun Lake. A lone individual, besieged by an army of over one hundred bronzed grackles and several blue jays, was found near the west end of Oconomowoc Lake on October 3, 1913.

Asio flammeus (Pontoppidan). SHORT-EARED OWL

A common migrant and winter resident, and on one occasion at least a summer resident, though so far as known not a breeding

species. A single individual frequented the large tamarack swamp near Golden Lake during the summer of 1912, but no nest was found and only the one bird was seen.

***Cryptoglaux acadica acadica* (Gmelin). SAW-WHET OWL**

A regular winter resident, and occasionally at least a summer resident; possibly even a breeding species, though there is no direct evidence. Dr. F. C. Rogers reports that "in June of 1912 three saw-whet owls roosted daily in a tree near the lake." This was near the east end of Oconomowoc Lake.

***Otus asio asio* (Linnaeus). SCREECH OWL**

A common resident found, though not abundantly, throughout the county. The birds breed in any suitable hollow tree, the eggs being laid about the third week in April. It may be of interest to note that, in the writer's experience at least, the gray plumaged bird is commoner than the brown in this region. The gray is apparently dominant, the brown recessive. Feeds largely on mice, though feathers of bluebird, house wren and song sparrow have been taken from a nest containing young.

***Bubo virginianus virginianus* (Gmelin). GREAT HORNED OWL**

A rare winter or very early spring visitor, and not a breeding species. On January 10, 1910, a single individual was shot near Pine Lake, and one bird was reported for January 3, 1911.

***Coccyzus americanus americanus* (Linnaeus). YELLOW-BILLED CUCKOO**

A common summer resident and breeding species, found throughout the region. More common than the black-billed species. It arrives later in the spring than that species, and leaves early in September.

***Coccyzus erythrophthalmus* (Wilson). BLACK-BILLED CUCKOO**

A regular summer resident and breeding species. Arrives early in May, and remains usually until severe frosts drive it south. Two were seen on October 3, 1913.

***Ceryle alcyon* (Linnaeus). BELTED KINGFISHER**

An abundant summer resident and breeding species. The first individuals arrive the last of March, but the birds do not begin to nest until well along in April, during which interval they are

extremely loquacious. Their principal food consists of bluegills (*Lepomis gibbosus*), perch (*Perca flavescens*), and small bass (*Micropterus dolomieu*). It is remarkable to note the large size of the fish caught, in proportion to the size of the bird; a bluegill which manage to wriggle away from a passing bird measured 14.5 cm. from tip to tip.

Dryobates villosus villosus (Linnaeus). HAIRY WOODPECKER

A common resident throughout the county, though never abundant. The birds breed in any suitable locality, returning year after year to the same hole if left undisturbed. Less commonly found in the summer than in the winter, when the birds come around the houses with utter fearlessness.

Dryobates pubescens medianus (Swainson). DOWNY WOODPECKER

A very common resident throughout the county. During the fall these birds become very tame, and may be attracted in numbers by suet or peanuts. Nests usually 6 to 8 feet from the ground.

Sphyrapicus varius varius (Linnaeus). YELLOW-BELLIED SAP-SUCKER

A common migrant, and occasionally a summer resident. Arrives very early in April when it does considerable damage to maple trees (*Acer saccharum*), and is seldom seen after the second week in May until the fall migration early in September. There has been a great decrease in the number of these birds during the last five years, and breeding records are very few at present.

Melanerpes erythrocephalus (Linnaeus). RED-HEADED WOODPECKER

An abundant summer resident, found occasionally the year round. Nests in any suitable stump, fence post or telegraph pole, irrespective of its situation, and at almost any height from the ground. One dead tree had two pairs of birds nesting in it at one time during 1912, and in 1913 this number was increased to five pairs.

Colaptes auratus luteus (Bangs). NORTHERN FLICKER

An abundant summer resident throughout the county. Nests in any convenient stump or tree. A pair chiseled a hole into a

hollow pillar on the porch of an unoccupied dwelling, and succeeded in raising their family despite the fact that the house was occupied before the young were out of the nest.

***Antrostomus vociferus vociferus* (Wilson). WHIP-POOR-WILL**

A regular migrant, no longer really common, and probably not a breeding species. Arrives during the first week of May, and often slips through on the fall migration unnoticed. Not nearly as common as the nighthawk, for which it is very often taken by the "sportsmen" of this region.

***Chordeiles virginianus virginianus* (Gmelin). NIGHTHAWK**

A regular migrant, and occasionally a summer resident. During June and July of 1912, a pair of nighthawks were seen on the wing nearly every night, and on July 27, their number was increased by two, undoubtedly the young. The autumnal flight of these birds was particularly fine on August 31 and September 2, 1913, when over two hundred and fifty individuals were seen over the west end of Oconomowoc Lake, where they paused to feed upon the enormous swarms of midges dancing over the water.

***Chaetura pelagica* (Linnaeus). CHIMNEY SWIFT**

An abundant summer resident, nesting in chimneys either in the city or in the country. During 1912 a colony nested in the chimneys along Main Street, Oconomowoc.

***Archilochus colubris* (Linnaeus). RUBY THROATED HUMMING-BIRD**

A common summer resident and breeding species. Often found around beds of *Salvia*, or resting upon telegraph wires. These birds arrive when the warbler migration is beginning—about the end of the first week in May, but nesting does not begin until the end of the month or early June. Rarely seen in the fall after the third week in September.

***Tyrannus tyrannus* (Linnaeus). KINGBIRD**

A common summer resident, breeding throughout the county. In June, 1913, a nest was found on an overhanging branch of a basswood (*Tilia americana*), within 10 inches of the water—just barely out of reach of the waves. In contrast to this, another nest was found in a cedar, fully 30 feet from the ground.

Myiarchus crinitus (Linnaeus). CRESTED FLYCATCHER

A rather uncommon summer resident, but a breeding species when found. Particularly common during the summer of 1913. Dr. F. C. Rogers of Oconomowoc says that "in July, 1913, a pair nested in a little house in a tree near my home." Another nest was found in a deserted woodpecker's hole near Golden Lake.

Sayornis phoebe (Latham). PHOEBE

A common summer resident found breeding under all suitable bridges. Arrives early and leaves early, and is seldom met after the second week of September.

Nuttallornis borealis (Swainson). OLIVE-SIDED FLYCATCHER

A more or less uncommon migrant, found during the latter half of June in the tops of high trees in rather dense woods. In 1912 and 1913 it was found near the outlet of Oconomowoc Lake.

Myiochanes virens (Linnaeus). WOOD PEWEE

A very common summer resident and nesting species. On June 8, 1913, a nest containing three eggs was found near Gifford Station in a red oak (*Quercus rubra*), 10 feet from the ground. Seldom seen after the first week of October.

Empidonax flaviventris (W. M. and S. F. Baird). YELLOW-BELLIED FLYCATCHER

Probably a regular migrant, though there is but a single record at hand at this time; on May 27, 1913, an adult male was taken near Oconomowoc Lake.

Empidonax minimus (W. M. and S. F. Baird.) LEAST FLYCATCHER

A common summer resident, nesting in suitable places. Found commonly around Dutchman's Lake.

Otocoris alpestris alpestris (Linnaeus). HORNED LARK

An uncommon winter visitant, found on the wind swept fields from November to about the middle of March. Rather erratic in occurrence; some years the bird is apparently entirely absent. Not nearly as common as the next.

Otocoris alpestris praticola Henshaw. PRAIRIE HORNED LARK

The common resident "shore lark" throughout the open field region of the county. They begin breeding very early, and a

nest was found during the last week of March, 1913, with the female sitting, when the ground was covered by a late fall of snow. Gregarious at all times, and several nests have been found on a very few square yards of territory.

Cyanocitta cristata cristata (Linnaeus). BLUE JAY

An abundant summer resident, and usually a winter resident as well; found practically everywhere. There is little complaint on account of the jay's egg-eating habit, but the farmers shoot them constantly as much, perhaps, because of their constant noise as because of their reputation for grain eating.

Corvus brachyrhynchos brachyrhynchos Brehm. CROW

A common resident, increasing steadily in numbers. The birds nest in almost any grove of trees, from 8 or 10 feet to almost any attainable height. Will return to the same nesting site year after year, reconstructing the old nest.

Dolichonyx oryzivorus (Linnaeus). BOBOLINK

A common summer resident, breeding in suitable places, and becoming abundant during the fall migration. On August 5, 1912, a flock of over four hundred settled in the marsh along the Oconomowoc River, where it remained for several days. The birds were all in nearly full winter plumage, despite the early date.

Molothrus ater ater (Boddaert). COWBIRD

A very common summer resident. The cowbird's ability to detect nests of species on which it can impose its eggs is truly remarkable. Four cowbird's eggs were removed on four consecutive days from the nest of a song sparrow, concealed in the heart of a dense Barberry hedge. The chief victims of the cowbird's imposition are the yellow warbler, redstart, song and field sparrows.

Xanthocephalus xanthocephalus (Bonaparte). YELLOW-HEADED BLACKBIRD

A common summer resident and breeding species, but very local in distribution. A colony breeds regularly in the rushes at the north end of Nagawicka Lake and another, smaller colony, about Ashippun Lake. It is an open question why the breeding area of this bird is so restricted, when there are plenty of apparently equally attractive regions throughout the county.

Agelaius phoeniceus phoeniceus (Linnaeus). RED-WINGED BLACK BIRD

An abundant summer resident, breeding in practically every swamp in the county. The males arrive about the second week in March, and are followed by the females after an interval of about a week. In the fall they congregate in immense flocks, often alighting in the grain fields, and it is then that the farmer plays havoc among their ranks.

Sturnella magna magna (Linnaeus). MEADOWLARK

A very common summer resident, found from the middle of March until the heavy frosts of late October or early November. Public sentiment is slowly swinging in favor of this bird, and it is far less "hunted" than formerly.

Icterus spurius (Linnaeus). ORCHARD ORIOLE

A regular summer resident, found in the less populated sections of the county, and but seldom seen in the vicinity of Oconomowoc.

Icterus galbula (Linnaeus). BALTIMORE ORIOLE

An abundant summer resident. The birds return year after year to a favorable nesting site, and a pair has nested on one of two adjacent branches of a large elm for four consecutive years.

Euphagus carolinus (Müller). RUSTY BLACKBIRD

A common migrant, arriving during the first week of April, and returning again during November. Seldom found in large flocks, as are the other blackbirds.

Quiscalus quiscula aeneus Ridgway. BRONZED GRACKLE

A very common summer resident, becoming superlatively abundant in the fall. During September the birds congregate in perfectly enormous flocks and invade the cornfields. Here they are slaughtered by the farmer. During the nesting season they are less gregarious, and solitary nests are common.

Hesperiphona vespertina vespertina (W. Cooper). EVENING GROSBEAK

Not an uncommon, though very irregular and erratic winter resident. Most of the records for the species are in February. On February 8, 1911, a flock of eight which remained in a very

limited area for three days, was reported from the south end of Pine Lake, and a flock of fourteen was reported from Oconomowoc on February 21, 1913. These two flocks are the only records during the last few years.

Carpodacus purpureus purpureus (Gmelin). PURPLE FINCH

A rather erratic migrant, arriving usually early in April. Never common, and only a few records are at hand, all between April 3 and 16.

Loxia curvirostra minor (Brehm). CROSSBILL

Another extremely irregular winter resident, and, so far as occurrence goes, the most erratic of our bird visitors. In 1910 a flock of five was seen on December 27, near Silver Lake. The birds were feeding on hemlock (*Tsuga canadensis*) and tamarack (*Larix laricina*) seeds, and were not the least bit timid.

Acanthis linaria linaria (Linnaeus). REDPOLL

A common winter resident, but of irregular occurrence. A flock of about thirty was noted near Golden Lake on December 30, 1912.

Astragalinus tristis tristis (Linnaeus). GOLDFINCH

A common migrant and summer resident, and occasionally only a winter resident. Nesting begins about the middle of August, and the young are often in the nest until well past the middle of September. In 1912, three nests were found in a small clump of willow at an elevation of about 30 inches, all within an area of approximately 30 square feet.

Spinus pinus (Wilson). PINE SISKIN

A rather erratic migrant and winter resident, found most commonly about evergreen or tamarack thickets during October or November, but its yearly appearance is not to be relied upon. Its favorite food is conifer seeds, and flocks will often be found busily engaged in extracting the seeds from hemlock cones. The fact that evergreens are not over common in Waukesha County may account for the uncertainty of this species' occurrence.

Passer domesticus (Linnaeus). ENGLISH SPARROW

Everywhere abundant, and always a nuisance.

Plectrophenax nivalis nivalis (Linnaeus). SNOW BUNTING

A common winter resident, found more in the open fields than near the lakes and river-courses, and then only where weeds are abundant, offering suitable food.

Calcarius lapponicus lapponicus (Linnaeus). LAPLAND LONG-SPUR

A common winter resident, arriving about the second week of November, and remaining until well into April, the latest date at hand being April 17, 1911. More common in the eastern half of the county than in the lake region, being more a bird of the large open fields.

Poocetes gramineus gramineus (Gmelin). VESPER SPARROW

A common summer resident and breeding species. On June 17, 1913, three nests were found in a cornfield, all with eggs about to hatch. One of our common summer sparrows.

Passerculus sandwichensis savanna (Wilson). SAVANNAH SPARROW

A regular summer resident, though more common on the early spring migration. Undoubtedly a breeding species, though there are no nesting records at hand.

Ammodramus savannarum australis Maynard. GRASSHOPPER SPARROW

A regular summer resident, found commonly but locally. Arrives during the latter part of April or early May. Probably will be found to breed.

Passerherbulus henslowi henslowi (Audubon). HENSLOW'S SPARROW

A regular, though never a common migrant, for which there are but few spring, and still fewer fall records. Because of its seclusive habits it is hard to say how early the bird arrives, but it is most apt to be seen during the third and fourth weeks of May.

Zonotrichia leucophrys leucophrys (J. R. Forster). WHITE-CROWNED SPARROW

A regular migrant, more common in the spring than in the fall. Found along brush-covered fences and in other thick shelter.

Zonotrichia albicollis (Gmelin). WHITE-THROATED SPARROW

A common migrant, arriving in the spring about the second week in April. In 1913 the fall migration began on September 13, and by the 17th the birds were common and in full song.

Spizella monticola monticola (Gmelin). TREE SPARROW

A common migrant and winter resident, found usually in large rocks about hedges and brush-piles. Arrives early in November and leaves by the middle of April.

Spizella passerina passerina (Bechstein). CHIPPING SPARROW

A common summer resident, nesting in suitable locations. In 1913, a pair nested in a small bay tree at the side of a busy road, and were perfectly fearless. The young birds were fed largely on the "cabbage-worm"—the caterpillar of *Pieris rapae*.

Spizella pusilla pusilla (Wilson). FIELD SPARROW

A common summer resident and nesting species. Greatly imposed upon by the cowbird. Arrives early in April, and leaves by the end of October.

Junco hyemalis hyemalis (Linnaeus). SLATE-COLORED JUNCO

A common migrant and winter resident, found along with the tree, fox and white-throated sparrows.

Melospiza melodia melodia (Wilson). SONG SPARROW

A very common summer resident, a few individuals remaining over the winter. Nests usually on the ground, but by no means always. A pair raised its family among the flower-pots of a green-house, and the female could be stroked while incubating. Suffers greatly at the hands of the cowbird. A young cowbird, just hatched, was placed in the nest of a song sparrow, when all but one of the young of that species had left the nest. The foster parents seemed not a bit surprised at this sudden and unexpected addition to their family, and spent two busy weeks cramming that cowbird full of "cabbage worms." Undoubtedly raises at least two broods a season under normal conditions.

Melospiza georgiana (Latham). SWAMP SPARROW

A common summer resident, found breeding in all suitable places. Arrives early in April, and remains until after the first severe frosts.

***Passerella iliaca iliaca* (Merrem). FOX SPARROW**

A common migrant, found most plentifully during the spring migration. Keeps to brush and tangled vines almost entirely.

***Pipilo erythrophthalmus erythrophthalmus* (Linnaeus). TOWHEE**

A common migrant, summer resident and breeding species. Arrives usually early in April, sometimes even the last of March, but nesting does not begin until the second or third week in May. Departs for the south about the middle of October.

***Zamelodia ludoviciana* (Linnaeus). ROSE-BREASTED GROSBEEK**

A common summer resident and breeding species. A pair has returned to the same crotch in an apple tree for three consecutive seasons to nest. In this instance the male incubated far more than the female, and very frequently sang while sitting.

***Passerina cyanea* (Linnaeus). INDIGO BUNTING**

A regular summer resident, though by no means abundant. In 1909 a pair nested in a young apple tree, the nest being but 18 inches from the ground, and without any concealment whatever.

***Spiza americana* (Gmelin). DICKCISSEL**

A regular, though not a common migrant, arriving during the latter part of May.

***Piranga erythromelas* (Vieillot). SCARLET TANAGER**

A common summer resident, found breeding in undisturbed woods. A pair or two usually nests east of the outlet of Oconomowoc Lake, and about the entrance of the Oconomowoc River to the lake.

***Pronges subis subis* (Linnaeus). PURPLE MARTIN**

A common summer resident and breeding species, found in abundance locally. The birds arrive over night in great flocks about the first of April, and leave again as suddenly about the middle of August. Previous to the fall migration they will be seen to congregate, usually along the telegraph wires or over the insect-swarming swamps. Something over four hundred martins were in evidence on August 19, 1913, and but two individuals were to be found on the morning of the 20th.

Petrochelidon lunifrons lunifrons (Say). CLIFF SWALLOW

A regular, though hardly a common summer resident, found breeding locally. In 1911, about twenty pairs nested around the barns of a farm on Golden Lake, and returned to the same place in 1913, after an absence of one year.

Hirundo erythrogastra (Boddaert). BARN SWALLOW

A very common summer resident, breeding in almost any barn or hen-house.

Iridoprocne bicolor (Vieillot). TREE SWALLOW

A common summer resident, found breeding in such areas as the large swamps near Golden Lake.

Riparia riparia (Linnaeus). BANK SWALLOW

A common summer resident, found breeding in fairly large colonies in suitable localities where sand-banks are available. There is a large colony that breeds yearly near Ashippun Lake, and another smaller one near Nagawicka. Often found nesting along railroad cuts.

Stelgidopteryx serripennis (Audubon). ROUGH-WINGED SWALLOW

A common summer resident, though not as abundant as the preceding species. Nests usually in holes in banks, but will, if necessary adapt itself to crevices in walls or stone piles.

Bombycilla cedrorum (Vieillot). CEDAR WAXWING

A common summer resident and breeding species, found nesting about mid August. The nests are bulky, and are often placed in evergreens, if there be any choice of nesting sites. One pair utilized over thirty feet of white string stolen from a nearby robin's nest.

Lanius ludovicianus migrans (W. Palmer). MIGRANT SHRIKE

A regular summer resident and nesting species, found breeding in the less frequented regions such as the dense thickets near Dutchman's and Henrietta Lakes.

Vireosylva olivacea (Linnaeus). RED-EYED VIREO

A very common summer resident, found nesting throughout the region, usually high in elm trees. Shares with the house wren the honor of being our most tireless songster.

Vireosylva philadelphica (Cassin). PHILADELPHIA VIREO

A common migrant, found usually early in May at about the height of the warbler migration.

Vireosylva gilva gilva (Vieillot). WARBLING VIREO

A common migrant early in May, and so far as is known at present, not a breeding species.

Lanivireo flavifrons (Vieillot). YELLOW-THROATED VIREO

An abundant migrant, and occasionally a summer resident. Two nests were found near the entrance of the Oconomowoc River to Oconomowoc Lake in 1910, and several more near the same locality in 1912 and 1913.

Lanivireo solitarius solitarius (Wilson). BLUE-HEADED VIREO

A common migrant, rarely found later than the 20th of May.

Mniotilta varia (Linnaeus). BLACK AND WHITE WARBLER

A very common migrant, often the second or third species of warbler to arrive.

Protonotaria citrea (Boddaert). PROTHONOTARY WARBLER

A regular migrant. On one occasion, at least, a summer resident, but there is no reason to believe a breeding species. In June and July, 1911, a pair was seen on several occasions in the big swamp area near Golden Lake, and all search failed to reveal any sign of a nest.

Vermivora chrysoptera (Linnaeus). GOLDEN-WINGED WARBLER

A regular, but rather uncommon migrant, arriving nearly at the height of the spring migration.

Vermivora rubricapilla rubricapilla (Wilson). NASHVILLE WARBLER

A common migrant. Is one of the early warblers to arrive, appearing early in May, and remains until the greater part of the warbler migration has passed.

Vermivora peregrina (Wilson). TENNESSEE WARBLER

A common migrant, arriving late in the spring, and usually found after all other migrating warblers have passed northward.

Compsothlypis americana (Linnaeus). PARULA WARBLER

A regular migrant, at times almost abundant, but rather erratic. Especially common the last week in May 1913.

Dendroica tigrina (Gmelin). CAPE MAY WARBLER

A regular migrant, though not usually very common. Almost abundant on September 8, 1913, when dozens of individuals were seen.

Dendroica aestiva aestiva (Gmelin). YELLOW WARBLER

An abundant summer resident, found nesting almost everywhere. Arrives the first week in May, and begins nesting the last of the month. Another victim of the cowbird.

Dendroica caerulescens caerulescens (Gmelin). BLACK-THROATED BLUE WARBLER

An abundant migrant during the last half of May and again during the first two weeks of September.

Dendroica coronata (Linnaeus). MYRTLE WARBLER

A very abundant migrant and the first warbler to arrive in the spring, appearing as early as the second week in April. The fall migration begins the third week in September, and individuals of this species are often seen until after the middle of October.

Dendroica magnolia (Wilson). MAGNOLIA WARBLER

A very common migrant, arriving during the first week of May. For a few days only, often one of the most abundant species in the fall migration.

Dendroica pensylvanica (Linnaeus). CHESTNUT-SIDED WARBLER

A common migrant, found often as late as the end of May, yet not, so far as is known, a breeding species in the county.

Dendroica castanea (Wilson). BAY-BREASTED WARBLER

An abundant migrant, arriving during second week of May and rarely seen after May 25. In 1913, the fall migration for this species began on September 6, when fourteen individuals were seen.

Dendroica striata (J. R. Forster). BLACK-POLL WARBLER

A common migrant, and often the last warbler to arrive on both spring and fall migrations. Although late, they are always

found in abundance, and more often in elm trees (*Ulmus americana*) than in others.

Dendroica fusca (Müller). BLACKBURNIAN WARBLER

A very common migrant, arriving about the first week in May, returning in the fall about the third week in September. Seemingly of rather erratic occurrence, some years almost entirely escaping notice, and other years almost abundant.

Dendroica Virens (Gmelin). BLACK-THROATED GREEN WARBLER

One of the most abundant migrants, common after the first week in May until the majority of the warblers have passed on, and again the third week in September. During the last two weeks of September, 1913, these warblers were found almost everywhere.

Dendroica vigorsi (Audubon). PINE WARBLER

A common migrant, especially in the spring migration, when it arrives very early in May, and is seldom seen after the third week. One of the most elusive warblers during the fall migration, keeping to the highest trees, and often entirely escaping notice.

Dendroica palmarum palmarum (Gmelin). PALM WARBLER

A common migrant, and the most abundant of the early warblers. Found throughout the county during practically all of May, and again during the third week of September.

Seiurus aurocapillus (Linnaeus). OVEN-BIRD

A regular migrant, and often, though not always, apparently, a summer resident nesting in quiet places. Heard only in the spring, its presence during the summer is apt to be overlooked because of its quietness, combined with its retiring habits.

Seiurus noveboracensis noveboracensis (Gmelin). WATER-THRUSH

A regular migrant, often arriving as early as April 25, and in the fall individuals are reported well into October.

Oporornis agilis (Wilson). CONNECTICUT WARBLER

A regular though not a common migrant, found late in May and occasionally early in June. On September 8, 1913, four were seen near Gifford Station.

***Geothlypis trichas trichas* (Linnaeus). MARYLAND YELLOW-THROAT**

A common migrant and summer resident in suitable localities. Found abundantly in the spring and fall among the bushes along the Oconomowoc River between Oconomowoc and Fowler Lakes.

***Wilsonia pusilla pusilla* (Wilson). WILSON'S WARBLER**

One of the last migrants to arrive in the spring, but common for a few days. The latest spring record is that of two seen on June 2, 1913.

***Wilsonia canadensis* (Linnaeus). CANADA WARBLER**

A common migrant and usually a late arrival, often just preceding the Wilson's warbler. Two were seen September 8, 1913. The birds are more common in the spring than in the fall.

***Setophaga ruticilla* (Linnaeus). REDSTART**

An abundant summer resident breeding throughout the county. The nests are often placed within two feet of the ground, and many are ravaged by the red squirrels (*Sciurus hudsonicus*) or chipmunks (*Tamias striatus*).

***Dumetella carolinensis* (Linnaeus). CATBIRD**

An abundant summer resident and breeding species, arriving during the first week of May, or possibly even the end of April. Nesting begins very soon after the birds arrive, and often two broods are raised a season.

***Toxostoma rufum* (Linnaeus). BROWN THRASHER**

A common summer resident and nesting species, arriving about the first week in May. In 1913, five nests were located: four in brush pine, all within 20 inches of the ground, and one on the ground in a patch of clover without any protection whatever.

***Troglodytes aëdon aëdon* (Vieillot). HOUSE WREN**

One of our commonest summer residents, nesting in any adaptable place, such as a wood-pile, an empty pipe, a decayed fence post, and nesting boxes having openings small enough to exclude the English sparrow. In 1911, a pair nested inside of an unused street lamp in Oconomowoc, filling the entire chimney with

small sticks. Two broods are nearly always raised a season, but in different nesting sites if possible.

Nannus hiemalis hiemalis (Vieillot). WINTER WREN

A regular migrant, often overlooked because of its small size and shy habits.

Cistothorus stellaris (Naumann). SHORT-BILLED MARSH WREN

A rather uncommon summer resident, found more frequently in the semi-dry marshes than in the wetter regions.

Telmatodytes palustris palustris (Wilson). LONG-BILLED MARSH WREN

An abundant summer resident, found breeding in almost every wet marsh in the county. Nesting begins about the second week of May, and as many as seven nests have been found belonging to a single pair of birds.

Certhia familiaris americana (Bonapart). BROWN CREEPER

A common migrant and winter resident. The earliest fall record is September 18, 1912, and individuals are rarely seen after the first week in May.

Sitta carolinensis carolinensis (Latham). WHITE-BREASTED NUTHATCH

A common resident and breeding species. Although exceedingly tame during the fall and winter, the nesting site is usually some out-of-the-way region, such as Golden, Dutchman and Ashippun Lake areas.

Sitta canadensis (Linnaeus). RED-BREASTED NUTHATCH

A fairly common migrant, more abundant in the spring than in the fall. There are no nesting records for the species, and it is certain that it does not ordinarily breed in the county, though a nest was found at Pine Lake in 1888.⁹

Penthestes atricapillus atricapillus (Linnaeus). CHICKADEE

An abundant resident, most common during the fall and winter. Nests about Golden Lake in deserted woodpecker holes, and young just out of the nest were found on June 2, 1913.

⁹ Kumlien and Hollister, *Birds of Wisconsin*, p. 124.

Regulus satrapa satrapa (Lichtenstein). GOLDEN-CROWNED KINGLET

An abundant migrant and winter resident. Arrives early in October, and is rarely found after the middle of April.

Regulus calendula calendula (Linnaeus). RUBY-CROWNED KINGLET

A common migrant, far less abundant than the preceding. Arrives during the first week of April, and often remains until the middle of May.

Poliophtila caerulea caerulea (Linnaeus). BLUE-GRAY GNAT-CATCHER

A common migrant, especially during the spring migration. Arrives early in the third week of May, and is often seen for but a few days.

Hylocichla mustelina (Gmelin). WOOD-THRUSH

A common summer resident, nesting in any suitable woods. Five pairs nested in the woods near Gifford Station in 1913. Soft maple (*Acer rubrum*) seems to be the favorite nesting tree, and the nest is seldom placed over 8 feet from the ground. An unusually low nest was found in these woods at an elevation of but 14 inches.

Hylocichla fuscescens fuscescens (Stephens). VEERY

Common only as a migrant during the middle of May and late September, and more abundant in the spring. September 7 is the earliest fall date recorded.

Hylocichla aliciae aliciae (Baird). GRAY-CHEEKED THRUSH

A common migrant, arriving about the first week in May. Found mostly in the rather dense maple woods, and the birds are quite timid. Fall migration begins the second week in September, and the species is then common until early October.

Hylocichla ustulata swainsoni (Tschudi). OLIVE-BACKED THRUSH

A common migrant in early May and September. Less secretive than the preceding, and is found as often along the roadside as in the woods. Often entirely missed on the fall migration.

***Hylocichla guttata pallasi* (Cabanis). HERMIT THRUSH**

An abundant migrant, arriving about the end of the first week in April, and often common until the third week in May. The fall migration begins about September 20, and small flocks of three or four—rarely single individuals—are found in sheltered places until early November.

***Planesticus migratorius migratorius* (Linnaeus). ROBIN**

An abundant summer resident, and occasionally as winter resident, though rare as such. Nesting begins about the second week of May, and a second brood is raised late in July. A peculiar nest found in 1910 contained common white string in lengths of from 3 inches to 2½ feet, and amounting to a total of 68 feet 4 inches! Where such a quantity of string was found is a mystery.

***Sialia sialis sialis* (Linnaeus). BLUEBIRD**

A common summer resident, at present steadily increasing in numbers. The birds arrive as early as the middle of March, and remain until late October. The usual nesting site is a deserted hole of the red-headed woodpecker, usually in a more or less exposed situation, but occasionally in the dense woods. In June, 1913, a nest with five eggs was found in the heart of a dense maple (*Acer saccharum*) grove near Oconomowoc Lake. Often a second brood is raised as late as the last of July or even early August.

HYPOTHETICAL LIST***Branta* sp? BRANT**

The writer has received innumerable reports of "brant," but has so far been unable to find anyone who can describe the bird, and no specimen can be located. Supposed to be more common in the spring than in the fall, and is only seen during migrating. The only definite information seems to be that the bird is not *Branta canadensis canadensis* (Linnaeus).

***Falco peregrinus anarum* Bonaparte. DUCK HAWK**

A single record for April 28, 1912, is the only report at hand, and as the writer considers this bird somewhat rare, he feels it advisable to await further data on the bird.

Lanius borealis (Vieillot). NORTHERN SHRIKE

The writer feels quite sure that he saw a single individual near Oconomowoc in December, 1912, but is unable to locate his data on this subject, and as no further reports are available, the bird is placed "on the shelf" for further reference.

Helmitheros vermivorus (Gmelin). WORM-EATING WARBLER

Reported from Golden Lake on May 3, 1912, but not on very satisfactory data, and we await further reports on the species.

Vermivora pinus (Linnaeus). BLUE-WINGED WARBLER

Reported from Golden Lake on May 2, 1912, but the writer feels grave doubts as to the correctness of the identification, and no specimen was secured. Probably does occur in the county as a rare migrant, but we must have a specimen before we give it place.

Dendroica cerulea (Wilson). CAERULEAN WARBLER

Undoubtedly occurs, but so far has not been observed.

Dendroica kirtlandi (Baird). KIRTLAND'S WARBLER

Reported repeatedly, but owing to the great rarity of this warbler, it can not be accredited a place until a specimen has actually been taken within our limits.

Wilsonia citrina (Boddaert). HOODED WARBLER

Reported from Golden Lake on May 5, 1912, but this is the only record, and as the bird was seen amid a flock of warblers, we await further records before placing it in the body of the list.

RECAPITULATION

Resident

(Birds marked with an asterisk have been found breeding.)

Herring Gull.	*Hairy Woodpecker.
*Mallard Duck.	*Downy Woodpecker.
*Bob-white.	*Prairie Horned Lark.
Ruffed Grouse.	*English Sparrow.
*Long-eared Owl.	White-breasted Nuthatch.
Saw-whet Owl.	*Chickadee.
*Screech Owl.	Prairie Chicken.
	*Blue Jay.

Winter Resident

Horned Lark.	Snow Bunting.
Evening Grosbeak.	Lapland Longspur.
Crossbill.	Slate-colored Junco.
	Redpoll.

Summer Resident

*Pied-billed Grebe.	*Red-winged Blackbird.
*Black Tern.	*Meadowlark.
*Bittern.	* Orchard Oriole.
*Least Bittern.	*Baltimore Oriole.
*Green Heron.	*Bronzed Grackle.
Black-crowned Night Heron.	*Vesper Sparrow.
*King Rail.	Savanna Sparrow.
*Virginia Rail.	Grasshopper Sparrow.
*Sora.	*Chipping Sparrow.
*Florida Gallinule.	*Field Sparrow.
Woodcock.	*Song Sparrow.
*Wilson's Snipe.	*Swamp Sparrow.
Solitary Sandpiper.	*Goldfinch.
*Spotted Sandpiper.	*Rose-breasted Grosbeak.
*Killdeer.	*Indigo Bunting.
*Mourning Dove.	*Scarlet Tanager.
*Marsh Hawk.	*Purple Martin.
*Sparrow Hawk.	*Cliff Swallow.
*Yellow-billed Cuckoo.	*Barn Swallow.
*Black-billed Cuckoo.	*Tree Swallow.
*Kingfisher.	*Bank Swallow.
*Red-headed Woodpecker.	*Rough-winged Swallow.
*Northern Flicker.	*Cedar Waxwing.
*Chimney Swift.	*Migrant Shrike.
*Ruby-throated Hummingbird.	*Red-eyed Vireo.
*Kingbird.	*Yellow Warbler.
*Crested Flycatcher.	*Redstart.
*Phoebe.	*Catbird.
*Wood Pewee.	*Brown Thrasher.
*Least Flycatcher.	*House Wren.
*Crow.	Short-billed Marsh Wren.
*Bobolink.	*Long-billed Marsh Wren.
*Cowbird.	*Wood Thrush.
*Yellow-headed Blackbird.	*Robin.
	*Bluebird.

Migrant

Holboell's Grebe.	Rusty Blackbird.
Horned Grebe.	Purple Finch.
Ring-billed Gull.	Henslow's Sparrow.
Bonaparte Gull.	White-crowned Sparrow.
Common Tern.	White Throated Sparrow.
Merganser.	Fox Sparrow.
Red-breasted Merganser.	Dickeissel.
Hooded Merganser.	Philadelphia Vireo.
Baldpate.	Warbling Vireo.
Green-winged Teal.	Blue-headed Vireo.
Blue-winged Teal.	Black and White Warbler.
Shoveller.	Prothonotary Warbler.
Pintail.	Golden-winged Warbler.
Wood Duck.	Nashville Warbler.
Readhead.	Tennessee Warbler.
Canvas-back.	Western Parula Warbler.
Scaup Duck	Cape May Warbler.
Lesser Scaup Duck.	Black-throated Blue Warbler.
Ring-necked Duck.	Myrtle Warbler.
American Golden-eye.	Magnolia Warbler.
Buffle-head.	Chestnut-sided Warbler.
Ruddy Duck.	Bay-breasted Warbler.
Canada Goose.	Black-poll Warbler.
Great Blue Heron.	Blackburnian Warbler.
Wilson's Phalarope.	Black-throated Green Warbler.
Pectoral Sandpiper	Pine Warbler.
Least Sandpiper.	Palm Warbler.
Red-backed Sandpiper.	Water Thrush.
Greater Yellowlegs.	Connecticut Warbler.
Yellowlegs.	Wilson Warbler.
Bartramian Sandpiper.	Canadian Warbler.
Sharp-shinned Hawk.	Winter Wren
Red-tailed Hawk.	Red-breasted Nuthatch.
Red-shouldered Hawk.	Ruby-crowned Kinglet.
Broad-winged Hawk.	Blue-gray Gnatcatcher.
Pigeon Hawk.	Veery.
Osprey.	Gray-cheeked Thrush.
Whip-poor-will.	Olive-backed Thrush.
Olive-sided Flycatcher.	Hermit Thrush.
Yellow-bellied Flycatcher.	

Migrant and Summer Resident

Loon.	Nighthawk.
*Coot.	*Towhee.
Semipalmated Sandpiper.	Yellow-throated Vireo.
Semipalmated Plover.	Ovenbird.
*Cooper Hawk.	Maryland Yellowthroat.
	Yellow-bellied Sapsucker.

Migrant and Winter Resident

Black Duck.	Tree Sparrow.
Rough-legged Hawk.	Brown Creeper.
Short-eared Owl.	Golden-crowned Kinglet.
	Pine Siskin.

Rare Visitant

Great Black-backed Gull.	Sandhill Crane.
Old Squaw.	Bald Eagle.
Whistling Swan.	Great Horned Owl.

Hypothetical List

Brant sp?	Blue-winged Warbler.
Duck Hawk.	Kirtland Warbler.
Northern Shrike.	Hooded Warbler.
Worm-eating Warbler.	Caerulean Warbler.

Summary

Resident	15
Winter resident	7
Summer resident	69
Migrant	79
Migrant and summer resident	11
Migrant and winter resident	7
Rare visitant	6
Hypothetical	8
Total	202

Known Breeding Species, 75

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF WISCONSIN, MADISON,
February, 21, 1914.

THE CHALCIDOID FAMILY TRICHOGRAMMATIDAE

II¹ SYSTEMATIC HISTORY AND COMPLETION OF THE CATALOGUE AND TABLE

By A. A. GIRAULT

Wenn die Fühlergliederzahl richtig angegeben worden ist, woran ich nicht zweifle, dann liegt darin schon ein gutes Unterscheidungsmerkmal von allen übrigen Gattungen dieser Familie.—ARNOLD FOERSTER.

INTRODUCTION

Although these words of Arnold Foerster were written more especially in connection with the genus *Trichogramma* the type genus of this family, yet today, somewhat over a half century later, they are as applicable to the family as a whole as they were to that genus then and as they still remain now. There was scarcely a genus in the family which had not been almost hopelessly confused because of wrong antennal conceptions and of this *Trichogramma* is one of the most notable examples. And not only this, but the same can be said for other structural characters of generic value, more especially the structure and form of the wings and their venation.

But still further than this, in spite of the fact that the family has been known for three-quarters of a century and quite a number of species have been described, some now being prominent, the total inadequacy of specific descriptions has been very conspicuous. Coloration had been relied upon almost exclusively, but, as I have shown recently, proves non-reliable and sometimes wholly inconsequential, so much so, that in certain genera it is impossible to distinguish many of the species at all by it, even when these species are compared side by side. And, moreover, because of the confusion as to generic characteristics, these brief colorational

¹ Part I, see this Bulletin, vol. 12, 1912, pp. 81-100. Since this second part was written (1909), I have added a large number of genera and species to the family and have made unforeseen advances in the study of the group. Part I is supplemented as needed.

descriptions of species, neglecting as they did morphological details, had left us completely at sea in regard to the position of quite a few of them, and these we should either have had to drop as being unrecognizable or else adopt the useless alternative of listing them under arbitrary genera as so many mere names. Hence in this family we found ourselves in the anomalous position of a science without system, a mere lot of unknown things which fooled us by being called names. It has been my pleasure with the aid of many other investigators, acknowledged elsewhere, to trace the confused lines back to basic ground, and it is my purpose in the preceding, the present and following papers, to present as clarified a groundwork for future advance of our knowledge of this group as is possible, and to aid somewhat in this progress at the same time. The words of Foerster quoted in the opening sentence have proved to be true and the sentence grasps the entire history of the group.

EXPLANATION OF THE WORK AND ITS SCOPE

Heretofore many systematists have contented themselves largely in expressing opinions. Thus a revision of a group is usually given in outline without explaining or accounting for the various changes made with the expectation that they will be accepted forthwith. But it is obvious to those who think, that this method is not only unsatisfactory but at the same time seriously negligent and really unfair. Quite often we find that explanations are not given for the reason that none are available, a little study soon convincing us that the position taken in regard to certain groups was because of personal opinion or even deliberate choice. This not only injects into nomenclature a dangerous element, that of varying personalities, but as well adds fogs and obscurities, and we find ourselves traveling a circle or leading to an infinity of nothings. In the preceding and following pages, therefore, I have avoided making any changes in the status of genera and species without giving the best available explanations, but at the same time have realized that in certain cases judgment alone could act, and when such is the case the fact is stated. I have also been extremely liberal when reviewing the literature by giving most of it in one place or another, for this is not only fair but at the same time largely a necessity in some cases, and in this case largely because

any revision of the group must be based entirely on the literature, most of the types of the old genera and species having been lost. Another reason is this: if all of the literature is correctly given there is no necessity for going back of this paper for information. This paper is, in effect, a reprint summary of previous literature.

Thus at the outset we found with this family: (1) The types of most of the old genera lost or non-existent; (2) the descriptions of some of the genera and many of the species inadequate for recognition; (3) the original descriptions of many of the genera changed by later authors apparently without valid reasons; and (4) a total lack of system in the present arrangement of the genera and species and the absence of a single serious study of the family as a whole. As a result we have been doubtful even in regard to the identity of the commonest and most important members of the family.

These being true, thought will show that any serious effort to bring order out of this chaotic condition will have to deal mostly with and depend upon the literature itself. And in doing this I have made a rigid application of the international code and also an effort to trace every unit back to its source; and, if reasonable, accepting the original as a basis for constructive work. In addition to this rigid study of the literature of the group I have made an effort to get together for detailed description as many specimens as possible and have been aided largely in this by Dr. L. O. Howard, who very kindly turned over to me all of these insects in the collections of the National Bureau of Entomology and of the United States National Museum. By collecting myself I have also added largely to the morphology of the group by being able to describe specimens from unmounted material and while it was still fresh and unshriveled.

Finally I may add that the literature of this group must be followed either literally or else advisedly and I hope to combine the two. The literature is tolerably clear; it only needs proper interpretation.

GENERAL SYSTEMATIC HISTORY OF THE FAMILY

Previous to the last half of the nineteenth century (1850), this family of chalcidoids was represented by but one or two genera

and species, which were included in the family *Eulophidae* or sometimes within the *Encyrtidae*. The earliest authentic mention of a species was, presumably, by Peck (1799) who mentioned *Trichogramma minutum* Riley as *Encyrtus* species. Over a third of a century later, Curtis (1829) mentioned *Calleptiles latipennis* Haliday under the binomial name "*Microma latipennis*," but gave no description of the species (see Haliday, 1833). This was the second mention of a species. Curtis mentioned *latipennis* in the following manner:

"595 *Microma*, W.

* 1 *flavopicta* W.

† 2 *flavoscutellata* Curt.

* 3 *atra* W.

† 4 *latipennis* Curt.

† 5 *Iridis* Curt."

Species of the family were next written about and the first genera discovered and described nearly simultaneously by two British entomologists, Westwood (1833) and Haliday (1833), the latter describing the "*Microma latipennis*" of Curtis as *Calleptiles latipennis* Haliday and the former describing *Trichogramma evanescens*. Because of the fact that this later genus and species was described one month earlier than the *Calleptiles* it became the type of the family. *Trichogramma* was described in June, 1833, and *Calleptiles* in July of the same year. Westwood thought the genus *Trichogramma* to be allied with what is now *Aphelinus* Dalman, hence eulophid, while Haliday placed *Calleptiles* in an unnamed tribe by itself. From the very beginning, these two genera fought for supremacy; even in its original description *Calleptiles* was questioned as being a synonym of *Trichogramma* by the editor of the journal in which it was described and subsequently it has been rejected as a synonym of the more fortunate Westwoodian genus by nearly every systematist dealing with the family excepting Aurivillius (1897). From the literature, I conclude that the two genera are distinct.

During the following year, in the laboriously compiled Hymenopterorum Ichneumonibus, Nees ab Esenbeck (1834) under the general heading "Genus XV *Eulophum* inserenda sunt genera, Eulopho similia," gave a brief paraphrased copy of Westwood's description of *Trichogramma* and under *Trichogramma evanescens*

added "Adnot. Conf. *Myina Atomos*, infra sub. No. 4 (*Cynips Atomos* Boy. de Fonsc.)." The reference is to pages 432-433 of the same work where the description of *Myina atomos* is given. This species is inadequately described and is now referred, I think doubtfully, to *Anagrus* Haliday (De Dalla Torre, 1898, p. 422). This arrangement of the species is probably wrong, as it is a gregarious egg-parasite and may therefore be a trichogrammatid. The point will be referred to later in a more fitting place. Hartig (1838) described *Encyrtus embryophagus*, which seems to belong to *Trichogramma*, as M. Kourдумoff informs me (*in litt.*, 1913).

The British entomologist Walker (1839, a) was the next to give the group attention. This was in his *Monographia Chalciditum*. Here, under the name *Pteroptrix evanescens*, he redescribes what, from internal evidence, we shall consider as none other than *Calleptiles latipennis* Haliday, giving *Trichogramma evanescens* Westwood and *Calleptiles latipennis* Haliday as synonyms. A distinct species, captured on windows, in London, was described and figured. Although obviously not making it a *Trichogramma* by calling it so, Walker caused almost hopeless confusion later in regard to that genus, a confusion which persisted to the present day and which succeeded in the elimination of *Calleptiles* until up to the present time. After this mistake of Walker, *Trichogramma evanescens* was merged with *Calleptiles latipennis* in such a manner that the names of the two were exchanged for their definitions so that although *Trichogramma* was the name, *Calleptiles* was the substance and finally the original definition of the former was rejected and the conception of the genus thus totally reformed.

In the year following, Westwood's (1840) introduction to the *Modern Classification of Insects* was published but nothing new was given concerning the *Trichogrammatidae*; the antennae of *Trichogramma evanescens* were figured practically as originally (Westwood, 1833) with slight differences in the relative size and shape of the six joints. In the *Synopsis of the Genera of British Insects*, appended to volume II, the *Hymenoptera* are divided into families and subfamilies, the genus *Trichogramma* Westwood listed within the subfamily *Encyrtides* Westwood with *Calleptiles* Haliday as a synonym. A brief diagnostic description of the genus is given which does not disagree with the original descrip-

tion of *Trichogramma*. Thus Westwood himself does not give up the original perception of *Trichogramma*, and later (Westwood, 1879) he is the one to point out that that genus and *Calleptiles* Haliday are distinct things.

During the next decade not very much was learned concerning the family, though Walker (1843-1846), Haliday (1842-1843) and Stollwerck (1848) wrote about the several existing species of the group, the latter concerning the life-history of a species representing a new genus made known several years later by Arnold Foerster (1851). Stollwerck's paper was important, however, as it made known for the first time the habits of one of the species of the family, foreshadowing the economic relations of the whole group. Haliday (1842) first figured Walker's *Trichogramma evanescens* Westwood (= *Calleptiles latipennis* Haliday), giving a figure of the whole insect with enlarged details of the wings, antennae and tarsi; this figure is known to have been drawn by Haliday which is a strong reason for believing the Walkerian and Halidayan species the same; that is, that Walker's *Trichogramma evanescens* Westwood and Haliday's *Calleptiles latipennis* are the same thing, considered as such by both Walker and Haliday, both having the original conception of *Calleptiles* in mind, yet calling the species *Trichogramma evanescens* Westwood. In 1843 Walker described *Trichogramma carina* Walker; this species I shall place in *Calleptiles* Haliday because of internal evidence—because Walker's conception of *Trichogramma* was that of Haliday's *Calleptiles* and because it agrees more with that genus than any other; a ring-joint was probably overlooked in the antennae. In 1846 Walker listed *Trichogramma evanescens* Westwood with the *Eulophidae*, giving *Calleptiles latipennis* Haliday and *Pteroptrix evanescens* Walker as synonyms. This was in a list of the hymenopterous insects in the British Museum and as the specimens of *evanescens* so-called were presented to the museum by Walker, it seems evident here that *Calleptiles latipennis* Haliday was meant, as formerly. In the meantime, Haliday (1843) in attempting a classification of the old family *Chalcididae* places *Trichogramma* Westwood in a group to itself, characterized by having 3-jointed tarsi, listing *Trichogramma evanescens* Westwood and omitting mention of any others as synonyms. In 1849, Stollwerck mentioned the discovery of *Poropoea stollwerckii* Foerster, but did not mention its name until later.

Thus, recapitulating, by the end of the first half of the nineteenth century we find but two described genera of the family, namely *Trichogramma* Westwood and *Calleptiles* Haliday with three species between them, *evanescens* Westwood of the first genus and *latipennis* Haliday and *carina* Walker of the second; the existence of another species had been foreshadowed by Stollwerck (1849). But at that time the types of the two known genera were hopelessly confused with each other; however, it was more or less recognized that they were somewhat anomalous in structure and were consequently occupying an uncertain place in the eulophid or encyrtid groups of genera and Haliday had gone so far as to place them in a separate tribe thus foreshadowing their recognition as a distinct family several years later (Foerster, 1856).

Entering upon the second half of the nineteenth century we find at the outset some notable additions to the knowledge of the group, culminating at the end of the half-century in a definite concept of its systematic relations and at least some arranged system of classification. In the first year of this half-century, Walker (1851) gave in MS. notes by Haliday a synopsis of the *Trichogrammini*, which, as the name implies, was ranked as a distinct tribe; three new genera were founded, namely *Chaetostricha* Haliday, *Brachista* Haliday and *Oligosita* Haliday, and Walker described in addition *Trichogramma vitripennis* Walker. Moreover, the tribe was divided into two sections, the first with the pubescence of the wings arranged in regular lines containing *Trichogramma* and *Chaetostricha*, the second section with the pubescence of the fore wings arranged irregularly or normally containing the genera *Brachista* and *Oligosita*; these two sections afterward were raised to subfamily rank (Ashmead, 1904). Haliday's synopsis is quoted herewith:

‘Synopsis of the Trichogrammini.’

“Trib. Trichogrammini. Tarsi trimeri. Tibiae anticae calcari apice inciso.² Antennae articulis 6,3 extremis in clavem coarctatis (an semper?): abdomen subsessile: statura *Aphelini* (*Myinae*) fere, et huic magis affines videntur quam *Eulophinis*; *Oligosita* vere pedibus gracilibus, tarsis 2^{di} parvis elongatis, alis longe fimbriatis *Thysani* speciem mentitur.

² The mention of this character is inexplicable to me, since it is characteristic of the family to lack cephalic spurs, or when present, to bear them very short and straight, the strigil absent.—A.A.G.

“*Generum Conspectus.*”

* Alae anticae seriatim pubescentes.

† Vena costam sinu tantum attingens ad ortum radii.

1. *Trichogramma*, *Westwood*.

†† Vena costam longius decurrens ante ortum radii.

2. *Chaetostricha*, n.g.

** Alae vage pubescentes.

† Alae anticae latae, margine subtiliter ciliatae.

3. *Brachista*, n.g.

†† Alae anticae angustae, longe fimbriatae (plumatae).

4. *Oligosita*, n.g.”

Haliday, MS.

Here we find the foundation of the classification of the family. The genus *Brachista* had no species named in connection with it and consequently is a *nomen nudum*. The types of the other genera were described in the same paper containing the generic diagnoses and are *Chaetostricha dimidiata* Haliday, and *Oligosita collina* Haliday. All of the genera thus far were described as bearing 6-jointed antennae, *Trichogramma* Westwood having scape, pedicel, 3 funicle joints (afterward known to be 1 ring-joint, 2 funicle joints) and a solid club; *Chaetostricha* having scape, pedicel, 1 funicle joint and a 3-jointed club; and *Oligosita* having the same as the preceding genus. *Calleptiles* Haliday is omitted, apparently, but here *Trichogramma* is intended for it.

In the meantime, Foerster (1851) described a new genus called *Poropoea* based on the species *stollwerckii* whose existence was first mentioned by Stollwerck as previously stated. This genus was described as having 7-jointed antennae in both sexes—scape, pedicel, 2 funicle joints and a 3-jointed club and its adequate description furnished the first definite knowledge concerning both sexes; it also had broad fore wings with the pubescence arranged in regular lines and the marginal and stigmal veins together forming a regular arch and allying the genus with *Trichogramma*; it is further characterized by having in the female a prominent exerted ovipositor. It was described from specimens reared from the eggs of an attelabid. At the same time Foerster also described another species under the name of *Trichogramma walkeri* bearing 6-jointed antennae (no ring-joint, 3-jointed club) and straight marginal vein of the fore wing; the latter broad with the pubescence arranged in regular lines and the antennae nearly similar for both sexes.

Rightly, later this species was removed to become the type of the new genus *Centrobia* Foerster (1856); the species differed from *Trichogramma* in lacking a ring-joint in the structure of the antennae, in having a 3-jointed club and a straight marginal vein. (Cf. Howard, 1909.)

Close upon Foerster's description of *Poropoea*, came its redescription as new by Ratzeburg (1852) under the name of *Ophioneurus*, based on the male of *O. simplex* new species and the female of *O. signata* new species, both reared from attelabid eggs. In the same place, later, in some Nachträge (id., p. 248) the female of *simplex* is also briefly described. *Ophioneurus simplex* is later pronounced synonymous with the type of *Poropoea* Foerster by Foerster (1856) who is confirmed in his opinion by Reinhard (1858, p. 23). The descriptions of the two agree in all essentials as do also the host relations. Foerster (1856) also placed *Ophioneurus signatus* in *Poropoea*, but as Reinhard (1858) points out later, this species is different from *Poropoea* and at first he placed it with *Chaetostricha* Haliday and then with *Lathromeris* Foerster. But I am more inclined to accept the original description as it stands and hence consider *Ophioneurus* valid with the species *signatus* as its type. The exerted ovipositor and its host relations are characteristics which may serve to identify it.

Four or five years later a great advance in our knowledge of the family was made through Arnold Foerster's (1856) Hymenopterologische Studien. The more or less scattered group of genera is raised to the rank of a family, separated from all other families of the complex *Chalcidiae* (homologous with the present superfamily *Chalcidoidea*) by the 3-jointed tarsi (Foerster, 1856, pp. 20, 26-27). The treatment and arrangement of the family is of such high order and of such fundamental importance in the systematic study of this group that Foerster's opening paragraph and his *Uebersicht* of the genera are quoted here in full. It is to be regretted that here and also earlier (ib., 1851) Foerster was misled in regard to the genus *Trichogramma* Westwood, relying too much on Walker (1842). With the exception of this pardonable error and one or two others of omission (see Mayr, 1904), the discussion of the family is of the highest excellence. It opens as follows and runs for about three and one-half pages, the *Uebersicht* being followed by concise discussions of the genera taken separately:

"21. Trichogrammatoidae. Diese kleine Familie, welche sich durch dreigliedrige Tarsen auszeichnet, enthält äusserst zierliche, aber auch sehr kleine Thierchen, welche nach dem Tode oft sehr stark einschrumpfen und einer genauen Untersuchung unübersteigliche Hindernisse in den Weg legen. *Walker* hat eine Synopsis dieser Familie aufgestellt, welche er *Trichogrammini* nannte. Er charakterisirt sie durch dreigliedrige Tarsen und den Schienendorn des vordersten Fusspaares, welcher an der Spitze eingeschnitten sein soll. Zu den vier Gattungen, welche *Walker* in seinem *Conspetus* aufführt und welche alle auch in hiesiger Gegend vorkommen, kann ich noch vier neue hinzufügen, von denen eine durch ihre Lebensweise von nicht geringen Interesse ist. Indem ich hier den *Conspetus* von *Walker* beibehalte, habe ich blos die neuen Gattungen einzureihen, was in der folgenden Uebersicht geschehen ist:

a. Vorderflügel reihenweise behaart.

b. Die Unterrandader verbindet sich nicht mit dem Vorderrand

Poropoea m.

bb. Die Unterrandader verbindet sich mit dem Vorderrand.

c. Die Unterrandader bildet, indem sie an den Vorderrand geht und als ramus stigmaticus wieder in das Flügelfeld hinabsteigt, einen Bogen; Fühler achtgliedrig

Trichogramma Westw.

cc. Die Unterrandader bildet keinen Bogen; Fühler mit weniger als acht Gliedern.

d. Flügel ringsum mit langen Wimperhaaren bekleidet

Chaetosticha Walk.

dd. Flügel hinter dem ramus marginalis bis zur Spitze nur mit einem kurzen Haarsaum bekleidet.

e. Fühler siebengliedrig, mit einem Ringel und viergliedrigem Endglied *Lathromeris m. **

ee. Fühler sechsgliedrig, ohne Ringel und mit dreigliedrigem Endglied *Centrobria m. ***

aa. Flügel nicht reihenweise behaart.

f. Fühler siebengliedrig *Asynacta m. ****

ff. Fühler sechsgliedrig.

g. Vorderflügel breit, am Rande mit zartem Haarsaum. *Brachysticha m.*

gg. Vorderflügel schmal, lang gewimpert

Oligosita Hal." Pp. 87-98.

* *Lathromeris* von *lathros*, a, ov, heimlich, verborgen, und *meris*, idos, der Theil. Der name bezieht sich auf die Fühlergeissel, in welcher die einzelnen Glieder enge vereinigt, Gleichsam verborgen erscheinen.

** *Centrobria* von *chentron*, to, Stachel, Spitze, überhaupt Alles, womit man sticht, also hier der *Bohrer* und *bia*, *he*, die Stärke. Der Name bezieht sich also hier auf den bei einem so kleinen Thierchen ungewöhnlich langen und starken *Legebohrer*.

*** *Asynacta* von *asunaktos*, on, unverbunden, unzusammenhängend. In dieser Benennung liegt ein Hinweis auf die Unterrandader, welche sich mit dem Vorderrande nicht verbindet.

* *Brachysticha* (= *Brachista Walk.*) von *brachus*, eia, u, klein, kurz, und *stuche*, *he* die Reihe; also mit einer Kurzen Reihe, was sich auf den Haarsaum der Flügel bezieht, welcher dicht gedrängte kürzere Haare, aber keine langen Wimperhaare zeigt."

As explained in the opening paragraph just quoted, Foerster based his arrangement of the genera of the family on the Conspectus of Haliday (Walker, 1851) the main divisions of the family being the same, the arrangement of the distal ciliation of the fore wings and the latter's venation being the characters upon which the division is based. Three new genera are added to the family, two of which were improperly and inadequately described, namely *Lathromeris* and *Asynacta*; the third genus—*Centrobia*—was based on the species *Trichogramma walkeri* Foerster, previously described in detail (Foerster, 1851). In the discussions of the genera immediately following the Uebersicht, Foerster announces the synonymy of *Ophioneurus* Ratzeburg with *Poropoea* Foerster, holding *Ophioneurus simplex* Ratzeburg the same as *Poropoea stollwerckii* and removing *O. signatus* to *Poropoea*; as explained elsewhere the latter species is retained now as the type of *Ophioneurus*.

In regard to the next genus discussed—*Trichogramma* Westwood—Foerster bases his conception of the antennal structures on Walker's (Haliday, 1842) figure and consequently is misled into considering them to be 8-jointed. To be consistent we must accept Westwood (1833–1879) as final in this respect as he both precedes and follows both Walker and Foerster. Foerster remarks concerning the genus: "Ich besitze von dieser seltenen Gattung * drei Arten, aber von jeder Art nur eine Spezies, an welcher die Fühler stark eingeschrumpft waren, so dass sie sich zu einer genauen Untersuchung, ohne das ganze Individuum zu zerstören, wenig eigneten, deshalb habe ich mich hier in Betreff der Angabe der Fühlerglieder auf die Gattungsdiagnose Westwood's und die Abbildung in dem Entomologist beschränken müssen. Wenn die Fühlergliederzahl richtig angegeben worden ist, woran ich nicht zweifle, dann liegt darin schon ein gutes Unterscheidungsmerkmal von allen übrigen Gattungen dieser Familie" (p. 88). This quotation and what immediately precedes it shows clearly that Foerster based his conception of *Trichogramma* largely on Walker and Haliday and therefore was misled concerning it. His remarks have much significance.

In the following paragraphs of pages 88 and 89 the other genera are discussed in the order in which they occur in the Uebersicht. The discussions are wholly concerned with pointing out the differentiating characters of the several genera and are quoted in full in their proper places. *Chaetostricha* Haliday is emended to *Chae-*

tosticha on etymological grounds but the emendation is (and has been) rejected as being untenable and unnecessary; even *Chaetrotinx* was mentioned as a possibly necessary emendation on the same grounds. Without explanation the fore wings of this genus are described as bearing long marginal cilia, though no mention of such was made in the original description. *Lathromeris* is then concisely described, the description based on the male about which all that is stated is "welches ich wegen der gelben Färbung des Schildchens *Lathromeris scutellaris* nenne." This, of course, is very inadequate description for the species, but the genus is accepted as valid and several North American species are now known. Under *Centrobia*, *Trichogramma walkeri* Foerster was written as *Calleptiles walkeri*; the characteristics of the genus are explained briefly. *Asynacta* is briefly characterized, but no species is named in connection with it and its status was that of a *nomen nudum*. Today, however, it is valid, its type species having been recently described by Mayr (1904). The genus has the venation curved nearly as in *Poropoea*, apparently described as having nearly similar antennae but differing in the wing pubescence and in having the ovipositor concealed. The name of *Brachista* Haliday is emended to *Brachysticha* which is of course to be rejected, the emendation having been made solely on account of the close similarity of the original name to *Brachistes* Wesmael. According to the present code, this similarity is more unfortunate than erroneous and *Brachista* Haliday consequently holds; at that time its status was that of a *nomen nudum* and Mayr is now the author of it under Foerster's emended name. In conclusion, *Oligosita* Haliday is briefly contrasted with the then *Brachista*.

Foerster's additions to our knowledge of the family are the most important which occur during the last half of the nineteenth century and for the sake of clearness in tracing the future history of the family a complete catalogue of the group up to the end of the year 1856 is here given.

Revised Catalogue of the Trichogrammatidae, Compiled to the End of the Year 1856.

Family Trichogrammatoidae Foerster, 1856.

(Type by implication: *Trichogramma* Westwood.)

Genus I. *Trichogramma* Westwood, 1833.

Synonyms: *Calleptiles* Haliday—Westwood, 1840, Synopsis, p. 73. (not real).

1. *evanescens* Westwood, 1883, p. 444, text-fig.

Calleptiles latipennis Haliday—Westwood, 1840, Synopsis, p. 73 (by implication).

Genus II. *Calleptiles* Haliday, 1833, pp. 340-341.

Synonyms: *Pteroptrix* Westwood—Walker, 1839, p. 13.

Trichogramma Westwood—Walker, 1839, p. 13; 1843; 1851.

Calleptiles Haliday—Walker, 1839, p. 13.

Trichogramma Westwood—Haliday, 1842, Walker, 1846, Foerster, 1856.

(No real synonyms.)

1. *latipennis* Haliday, 1833, p. 341.

"*Microma latipennis*" Curtis, 1829.

Pteroptrix evanescens—Walker, 1839, p. 13.

Calleptiles evanescens—Walker, 1839, p. 13.

Trichogramma evanescens—Walker, 1839, p. 13; 1846, p. 61. Haliday, 1842.

Trichogramma evanescens Westwood—Foerster, 1856, p. 85; Walker, 1872.

2. *carina* Walker.

Trichogramma carina Walker, 1843, p. 104.

3. *vitripennis* Walker, 1851.

Trichogramma vitripennis Walker, 1851, p. 212.

Chaetostricha Haliday, Walker, 1851, p. 212.

Genus III. *Chaetostricha* Haliday, Walker, 1851, p. 212.

Synonyms: *Chaetosticha* Foerster, 1856, pp. 87, 89.

Chaetostrix Foerster, 1856, p. 89.

1. *dimidiata* Haliday, Walker, 1851, pp. 211-212.

Genus IV. *Brachista* Haliday, Walker, 1851, p. 213.

Synonym: *Brachysticha* Foerster, 1856, pp. 88, 90.

Nomen nudum.

Genus V. *Oligosita* Haliday, Walker, 1851, pp. 212, 213.

1. *collina* Haliday (Walker, 1851, p. 212).

Genus VI. *Poropoea* Foerster, 1851, pp. 28-29, tab. I, fig. 10, a-e; footnote to p. 28.

Synonym: *Ophioneurus* Ratzeburg, 1852, pp. 196-197, text-figs.

No real synonyms.

1. *Stollwerckii* Foerster, 1851, pp. 29-30, tab. 1, figs. 10, a-e.

Ophioneurus simplex Ratzeburg, 1852, p. 197, 247, text-fig.

Genus VII. *Ophioneurus* Ratzeburg, 1852, p. 197, text-figs.

1. *signatus* Ratzeburg, 1852, p. 197, text-figs.

Poropoea signata Ratz.—Foerster, 1856, p. 88.

Genus VIII. *Lathromeris* Foerster, 1856, p. 87 and footnote and p. 89.

1. *scutellaris* Foerster, 1856, p. 89.

Genus IX. *Centrobria* Foerster, 1856, p. 87 and footnote and p. 89.

Synonym: *Trichogramma* Westwood—Foerster, 1851, p. 26. No real synonym.

1. *walkeri* Foerster, 1851, pp. 26–28 and footnote to p. 27, tab. 1, fig. 9, a. b. c.

Trichogramma walkeri Foerster, *ibid.*

Calleptiles walkeri Foerster, 1856, p. 89.

Centrobria walkeri Foerster, *ibid.*

Genus X. *Asynaecta* Foerster, 1856, p. 87 and footnote and pp. 89–90.

Nomen nudum.

To this list may be added *Encyrtus embryophagus* Hartig, being probably a species of *Trichogramma*.

Thus, by the year 1856 ten genera of the family had been recognized including exactly ten species all of which, however, were not equally divided between the genera, two of the latter having no species named in connection with them. In spite of the progress in knowledge of the group, the synonymy had become somewhat involved, as is readily seen by looking over the brief catalogue. We may now enter somewhat more conveniently into the history of the group from the time of Foerster to the end of the year 1912.

During the same year that Arnold Foerster published his important, epochal contribution to our knowledge of this family, the first American reference to the group was made. Asa Fitch (1856) described two parasites of the larva of *Hemerocampa leucostigma* Smith and Abbot under the names "*Trichogramma? Orgyiae*" and "*Trichogramma? fraterna*," both of which, it now seems certain, belong to some other group than ours. They have been referred to in part 1 of this paper. In 1857, Stollwerck added much to our knowledge of the economy of the group by giving his observations on the habits and life-history of *Poropoea stollwerckii* Foerster; this paper was important as it added the first known of the habits of any species of the family showing that the *Poropoea* passed its entire cycle within the egg of an attelabid beetle, excepting when adult. These observations form some of the most important which have as yet been made concerning the biology of these minute insects. In 1858, H. Reinhard published some brief but important notes, entitled "*Beiträge zur Geschichte und Synonymie der Pteromalinen*" (continued) in which he discusses *Ophioneurus simplex* Ratzeburg which at first he refers to *Trichogramma* Westwood; and *O. signatus* Ratzeburg which he refers to

Chaetostricha Haliday. This will also be discussed in the proper place; but in passing it should be noted that Reinhard was wrong in both instances and in a *Nachtrag* to the same paper, after seeing Foerster (1856), he corrects the first accordingly (to *Poropoea stollwerckii* Foerster). Also, during the same year in the same journal (Reinhard, 1858, p. 323) he states again that *Ophioneurus simplex* Ratzeburg is *Poropoea stollwerckii* Foerster but that *Lathromeris* Foerster is the same as *Ophioneurus signatus* Ratzeburg. This opinion is more correct than the first, for the species *signatus* is either *Lathromeris* or a new genus in itself, and if its original description is accepted, and I can see no other way out of this dilemma, assuredly *Ophioneurus* Ratzeburg stands with *signatus* Ratzeburg as its type species. I have included the genus accordingly.

The next decade (1859–1868) produced little, with the exception of Lubbock's description of *Prestwichia aquatica*. Yet Stollwerck (1861) added further observations on the habits of *Poropoea stollwerckii* and Leopold Kirchner published his *Catalogus Hymenopterorum Europae* in 1867 at Vindobonae (= Vienna, Austria). This catalogue included the genera *Poropoea* Foerster, *Trichogramma* Westwood, *Chaetostricha* Haliday, *Centrobia* Foerster, *Asynacta* Foerster, *Brachysticha* Foerster and *Oligosita* Haliday with six species divided between them. The catalogue relatively is very incomplete as regards the family under consideration, a number of the species and genera being omitted, and besides it is carelessly compiled. But for historical purposes the entire list is quoted herewith:

“C. Trimera.

Subfamilia XXII. Trichogrammatidae Förster.

704. G. *Poropoea* Förster. Verh. Ver. pr. Rhld. VIII, 1851.

1. P. *Stollwerckii* Först. Parasit in den Eiern v. *Attelabus curculionoides*.

Ophioneurus simplex Rtz. 1852. Deutschland, Brühl, Kaplitz, Turin.

705. G. *Trichogramma* Westwood. Phil. Mag. 1833, p. 444.

1. T. *evanescens* Wst. England, Kaplitz.

706. G. *Chaetosticha* Walker. Monogr. Chalc. 1839. (*Lathromeris* Först. 1856.)

1. Ch. *signata* Rtz. Darmstadt, Dornbacher Park.

Ophioneurus signatus Rtz. Ichn. d. Fortsins. III, 197. Gez. aus den Blattrollchen von *Rhynchites Betulae*.

2. Ch. *scutellaris* Först. Aachen.

707. *G. Centrobia* Förster Hym. Stud. II, 87.
 1. *C. Walkeri* Förster Aachen, England, Galizinberg n. Wien.
Calleptiles Walkeri Först. Verh. nat. Ver. Rheinl. VIII, 1851, 26.
708. *G. Asynacta* Förster l.c.
 1. *A. sp.?*
709. *G. Brachysticha* Först. (*Brachista* Walk.)
 1. *B. sp.?*
710. *G. Oligosita* Haliday. Hym. Brit. 1839.
 1. *O. Daedalea* Först. Aachen Kaplitz, Laxenburg. Gezogen aus
 Baumschwamm.
 (?) Fam. Blastophagidae m.
711. *G. Blastophaga* Grav. Beitr. Ent. 1829.
 1. *B. psenes* L. (*grossorum* Grh.). Südeuropa.
B. Sycomori Wstw. 1857.
Psenes caprifici Gasparini Caprif. 1845.

Anmerkung zu den Trichogrammatiden.

Diese interessante Familie enthält die kleinsten und zartesten Thierchen, deren Genera nur mit Sicherheit bestimmt werden können, wenn davon mikroskopische Präparate in Glycerin angefertigt werden. Mit der schärfsten Lupe besehen, auch unter das Compositum gegeben, sind die Fühlerglieder im trockenen Zustande zuweilen schlechterdings nicht zu unterscheiden. Dr. Förster spiest diese Pygmaeen mit seltener Gewandtheit auf Silberdraht, wodurch wohl ihr Umfang allseitig besehen, aber die Genera noch immer nicht mit Sicherheit bestimmt werden können. So ist es auch mit der Unterrandader bezüglich ihrer Verbindung oder Nichtverbindung mit dem Vorderrande; dann ob diese Ader, wenn sie an den Vorderrand geht und *as ramus stigmaticus* wieder in das Flügelfeld hinabsteigt, einen Bogen bildet. So konnten z. B. die Diagnosen von *Oligosita Haliday* und *Brachista W.* schon bei ihrer Aufstellung nicht sicher gestellt werden, indem beide Hymenopterologen 6gliedrige Fühler angeben, während selbe in der That 7gliedrig sind, und sich durch ganz andere Charaktere von *Asynacta Förster*, die ebenfalls 7 Fühlerglieder hat, unterscheiden. Ich fertigte von diesen kleinen Thierchen mikroskopische Präparate und es gelang mir, ganze Individuen zu fixiren, so zwar, dass alle Theile deutlich und sichtbar hervortreten, und noch nach Jahren zur Demonstration sich eignen. Pp. 187-188.

The incompleteness of Kirchner's catalogue may be seen by comparing it with the one previously given for the year 1856. He includes the genus *Blastophaga* Gravenhorst and an undescribed species of *Oligosita*, omitting any mention of the type species of the genus. Kirchner also makes the genus *Lathromeris* Foerster a synonym of *Chaetostricha* Haliday but this and other obvious errors are too weightless to merit further discussion.

During the next thirty years a great deal was added to our

knowledge of the group, much of which unfortunately but served to lead to confusion. This was due to the great difficulty attending the study of this group and mainly to wrong antennal perceptions. Very few new groups were added during these years but the number of known species was sensibly increased and the knowledge of the complex host relations of some of the commoner species much enhanced. American entomologists took the lead. In 1871, Charles Valentine Riley described *Trichogramma minutum* which subsequently has led to confusion by Riley's proposal of *Pentarthron* as a generic name for it. Consultation of Riley's description and figures of this insect (Riley, 1871, 1879, 1881) and its synonym described later—*pretiosum*—shows distinctly that Riley did not count the ring-joint of the antenna as a true joint as he states (Riley, 1879), and both of his figures of the two species are identical in essential details, especially as regards antennal structures. For the time at which they were drawn and printed these figures are excellent likenesses of the same thing drawn at different times and from different material under different conditions. Since then nearly all systematic workers in this group, excepting Ashmead and one or two others of less importance, have strongly suspected *Pentarthron* to be the same as *Trichogramma* Westwood; from all of the evidence obtainable from the literature, and from the general probabilities, I shall consider the inferences drawn by these experienced men to be correct and shall not hesitate at all in agreeing with Aurivillius (1898) in placing *Pentarthron* Riley (= *Pentarthrum* Riley, de Dalla Torre, 1898) among the synonyms of *Trichogramma* Westwood.³

In connection with the *Trichogrammatidae*, other than historically, the only reason for calling attention to the Schetsen of Snellen van Vollenhoven (1871) is for the purpose of warning others against putting any trust at all in the figures given of the genera *Trichogramma* Westwood, *Poropoea* Foerster, *Chaetostricha* Haliday and *Centrobia* Foerster, a condition of affairs most unfortunate considering the labor involved, the good general execution of the figures, and the great aid, which if accurate, these figures would have been. The figures are good as meaningless drawings, but as

³ See Girault 1911j, where the matter is fully treated. Dr. L. O. Howard had informed me that he has seen the type of *Trichogramma* and that it is the same as the common *minutum* Riley—that is, generically.

illustrations of generic types they contain such grossly perverted details of structure that their existence is obstructive. Newman, during this same year (1871) records *Trichogramma evanescens* Westwood (= *Calleptiles latipennis* Haliday?) from the eggs of "Smerinthus populi," which were determined by Walker for a correspondent of the *Entomologist* of London.

The following year Walker (1872) in his Notes on *Chalcidiae*, parts VI and VII, translates almost literally Foerster's (1856) *Uebersicht* of the genera, exactly as follows (id., part VI, p. 105):

Fam. 20. Trichogrammatidae.

A. Fore wings with lines of hairs.

a. Humerus and ulna not united. Poropoea.

b. Humerus and ulna united.

* Antennae 8-jointed. Humerus forming a curve. . . Trichogramma.

** Antennae with less than eight joints. Humerus not forming a curve.

† Wings fringed around with long hairs. Chaetosticha

†† Wings with some short hairs between the radius and the tip.

‡ Antennae 7-jointed, with a ringlet and with a 4-jointed club.

Lathromeris.

‡‡ Antennae 6-jointed, with no ringlet and with a 3-jointed club.

Centrobria.

B. Fore wings without lines of hairs.

a. Antennae 7-jointed. Asynacta.

b. Antennae 6-jointed.

* Fore wings broad, with a pubescent border. Brachista.

** Fore wings narrow, fringed with long hairs. Oligosita.

Poropoea and Ophioneurus, *Ratz.*, are one genus. *Brachista*, *Hal.*, is altered by Foerster to *Brachysticha*. P. 105.

In part VII of the same work (id., p. 114) *Calleptiles latipennis* Haliday is figured under the name of *Trichogramma evanescens* Westwood—the adult female with the wings spread and enlarged tarsus, fore and posterior wing and female antenna, the figure being practically the same as given previously by the same author (Walker, 1842), with minor details added or changed, giving the impression of a patched original. This figure has already been commented upon. It was in 1872 also that Packard recorded the description of *Trichogramma minutum* Riley and the provisional proposal of *Pentarthron* Riley for that species.

Again the following year, Walker (1873) republished the figure

of *Calleptiles latipennis* Haliday of 1872 in a series of short papers on the *Economy of the Chalcididae* merely stating that *Trichogramma*, meaning *Calleptiles*, is the smallest and most simple of the family and that it lives in the eggs of Lepidoptera. Dours' *Catalogue Synonymique des Hymenopteres de France* appeared in 1874. This quotation comprises what it contains of the family under consideration:

C. Trimeræ.

Subfam. XXII. Trichogrammatidae. Foerst.

Trichogramma. Westw.

1. T. evanescens. Westw.
Chaetosticha. Walk.
1. C. signata, Ratz. Par. de Rhynchites betulæ.
Blastophaga. Grav.
1. B. psenes. L.
2. B. grossorum. Grav.
b. sycomori. Westw. (p. 111.)

It is needless to say that this list is without value.

Four years afterward the Swedish entomologist Thomson published his classification of the *Chalcididae* (= *Pteromalidae* Thomson) in which the *Trichogrammatidae* are classed as the tribe *Trichogrammina* of the section *Microcentri*. It is very briefly described as follows: "Alae lineis pluribus setiferis ornatae. Pedes tarsis triarticulatis." Then follows: "Genus *Ophioneurus*⁴ Ratzeburg. Alea postcosta marginem alae haud attingente, sed in medio fere sigmoideo." Under this genus, the only one mentioned, *O. grandis* Thomson is described. The species is incorrectly placed and belongs, as far as I am able to determine from its description, to *Poropoea* Foerster.

In 1879 (Riley; Comstock, 1879) Riley described *Trichogramma pretiosa* from the eggs of *Alabama*, comparing it with *minutum* and stating: "I have proposed the generic name of *Pentarthron* for *minuta* in MS. now in Mr. Scudder's hands, but until the allied genera are better characterized than at present, it is best to use the old genus *Trichogramma*." In the same year Westwood published an important paper in this connection adding several new species and some additional descriptive notes on described species and genera. Here he discusses *Prestwichia aquatica* Lubbock

⁴ Misspelled in the original "Ophioneurns."—A. A. G.

which, he rightly believes, belongs to this family and not to the *Myrmecidae*. The genus *Trichogramma* is then discussed and emended, or rather redescribed, the antenna and fore wing figured, and here Westwood shows distinctly a 6-jointed antenna with the articulated club in doubt, referring to it thus: "Nor am I clear that the large oval apical joint is not in reality composed of two or three^o joints closely soldered together." With this conception in mind he therefore indicates the supposed several (three) club joints by means of dotted lines in the figure, though the implication is plain that these joints were not actually seen. As redescribed, therefore, the antennae are composed of a scape, pedicel ring-joint, 2 funicle joints and a solid club—the latter point doubted because of the author's preconception—and these structures, coupled with the morphological details of the fore wing as figured, are certainly borne out by the species now referred to this genus. Westwood then calls attention to the fact that Walker's (1842) figure of *Trichogramma evanescens* Westwood (= *Calleptiles latipennis* Haliday), "Differs in several important respects from my insect and its details, and evidently represents not only another species with a dark band across the fore wings, but probably a male insect, while mine was most probably a female." Westwood next mentions (*Trichogramma*) *Centrobia walkeri* (Foerster), "Which has the antennae 4-jointed or (if the last joint consists, as the author supposes possible, of three joints soldered together) 6-jointed—the first of moderate size, the second and third equal, subovate, and nearly as large as the basal joint, and the terminal part of the antennae forming an elongated oval mass, the whole antennae being very slightly setose." But Foerster leaves no doubt behind him concerning the structure of the antennae of *walkeri*, the figure of it and his description showing six distinct joints, three of which belong to the club. *Poropoea* and *Ophioneurus signatus* Ratzeburg are then briefly characterized without criticism. A brief review of the whole group is then given, quoting Haliday's (Walker, 1851) synopsis and Foerster's *Uebersicht*, remarking that *Prestwickia* Lubbock must be placed without doubt in the last section of Haliday's synopsis corresponding with the *Oligositinae* of today. *Oligosita subfasciata*, *O. staniforthii* and *O. ? nodicornis* are then figured and described as new and in addition *Trichogramma* (*Aprobosca*) *erosicornis*. The latter was based on a single male

specimen and perhaps does not belong to *Trichogramma*; its position is decided elsewhere. This contribution by Westwood is timely and throws much light on one genus at least, namely, *Oligosita* Haliday, though the ring-joint of course may not have been overlooked by Haliday in the first place.

During the following year, Ashmead (1880) described *Trichogramma flavus* captured on orange leaves in Florida; from the somewhat crude figure and from the statement in the description that the tarsi are 5-jointed, it is obvious that this insect is not a trichogrammatid but its habitus and description make it very probable that it belongs to the eulophid subfamily *Aphelininae*, tribe *Aphelini*. I shall not attempt to place it.

The remainder of our knowledge of the family is furnished largely by American entomologists, commencing with Riley and Packard and ending with Ashmead. Packard (1883) redescribed *Trichogramma* as having 5-jointed antennae—scape, pedicel, 2 funicle joints and a solid club, overlooking the ring-joint; he very briefly redescribes *Trichogramma minutum* Riley from four male specimens reared from the eggs of *Limenitus disippus* and supplied by Riley, and also *T. minutissimum* new species from males and females reared from the eggs of *Papilio turnus* Linneaus. The description is very brief. The latter species is correctly placed as it is directly connected with the generic description of the genus. In 1886 Howard republished a translated synopsis of the *Trichogramminae* practically giving Foerster's (1856) Uebersicht, but replacing *Poropoea* by *Ophioneurus* and *Brachista* by *Brachysticha*. No comments are made. The same table is repeated the following year by Cresson (1887) who also lists the genus *Trichogramma* from North America with 7 American species, *orgyiae* Fitch, *fraternum* Fitch and *minutum* Riley being questioned. The positions and validity of these species have already been dealt with. This list with the exception of *odontotae* Howard had been previously published by Howard (1885, a) where *minutum* was held to be valid. In the meantime, Howard (1885, b) described *Trichogramma odontotae* from the eggs of the coleopteron *Odontota suturalis*, and Ashmead (1888) *Trichogramma acuminatum*, *nigrum* and *ceresarum*. The last three species were not true *Trichogrammae*, as the American conception of the genus was somewhat varied, and Ashmead later was in doubt concerning at least one of the

species (Ashmead, 1894-1895). Their correct position has been ascertained.

In 1889 Howard described *Trichogramma intermedium* and gave a diagnosis of the genus as follows:

"Genus *Trichogramma* Westwood.

Tarsi 3-jointed; front wings with regular rows of hairs, submarginal vein reaches costa, and, with marginal and stigmal, forms a regular arch; antennae 8-jointed—scape, pediceal, ring-joint, funicle (2), club (3)—; ring-joint very minute; funicle joints in female small and subequal in length and width; club large, obliquely truncate at tip. In the male the funicle joints are much larger and the club is of same width, tapering gradually to rounded tip."

The species *intermedium* is figured, showing a typical *Trichogramma* with the usual solid club; it was reared from butterfly eggs. From this diagnosis of the genus it may be inferred that the American entomologists were also largely confused by preconceiving the antennal club as necessarily 3-jointed, and while the genus was described as bearing such an antenna the species included within it actually, at least as far as we are able to learn from the literature, bore solid antennal clubs.

Ashmead in the fifth year following, described *Brachysticha fidiae* from the eggs of a coleopteron and remarked, following the description, that perhaps his *Trichogramma acuminatum* should be removed to this genus also, as it agreed closely with the species *fidiae*. The latter species belongs to *Lathromeris* Foerster; I have seen specimens of it. In 1895 Dyar without explanation gives *Trichogramma minutissimum* Packard as a synonym of *T. pretiosa* Riley. In 1898 *b*, Howard described a new genus and species, *Paracentrobia*, from the island of Grenada; it was based on the species *punctata*, a single female specimen captured on a window. A careful comparison of this description with *Chaetostricha* Haliday leads to the belief that the two genera are the same and *Paracentrobia* is considered as a synonym of the Halidayan genus, described so many years previously. In the same year, Howard (1898 *a*) described *Lathromeris cicadae* which I have later redescribed from the types.

Two more very important contributions to our systematic knowledge of this family await our attention. The first appeared in 1897 by the Swedish entomologist Aurivillius, and the second in 1904 by Ashmead. Both contributions are in the nature of re-

vised synopses of the genera, the latter made by one of large experience in the study of these minute parasites and their allies. In describing the new genus *Oophthora*, Aurivillius reviewed the literature of the whole family which he summed up in a generic synopsis of the family of some weight and importance, and some of which I shall accept. The table is given in Scandinavian and Latin and I quote that given in the latter language as being the one more easily read. Aurivillius follows Thomson (1878) in ranking the group as a subfamily but bases his synopsis on Foerster's *Uebersicht*, very properly not following him blindly, however. The Latin portion of the table is quoted at once:

A. Alae anticae seriatim setosae.

a. (Postcosta alar. ant. marginem costalem haud attingens. Antennae fere filiformes, 7-articulatae. Terebra feminae longe exserta!)

1. *Poropoea* Först.⁵

b. (Postcosta alar. ant. spatio plus minus longo cum margine costali connexa.)

*. (Stigma arcuatum.)

§. (Antennae 8-articulatae, funiculus triarticulatus, clava triarticulata.)

2. *Calleptiles* Halid.⁶

§§. (Antennae 6-articulatae, anello singulo, funiculo biarticulatae, clava solida.)

1. (Abdomen transversum, thorace brevius.)

3. *Trichogramma* Westw.⁷

2. (Abdomen subcylindricum, thorace longius.)

4. *Oophthora* Aur.⁸

** (Stigma rectum, margini costali arcuato adhaerens.)

1. (Clava antennarum crassa, 4—5-articulata, pedicello multo latior.)

5. *Chaetostricha* Halid.⁹

2. (Clava antennarum elongata, triarticulata, pedicello vix

(End of p. 252)

latior; funiculus 1-articulatus. Terebra feminae longa, corpore vix brevior.)

6. *Centrobia* Förster.¹⁰

⁵ Verh. naturh. Ver. preuss. Rheinl. 8, p. 28, t. 1, f. 10a-c. (1851.) Typ. *P. Stollwercki* Först. (= *simplex* Ratzb.) Klöckert u. z. äggen af *Attelabus curculionoides* = *Ophioneurus* Thomas, Hymenopt. Scand. 5 p. 299 (1878).

⁶ Haliday Ent. Magaz. 1 p. 340 (1833); = *Trichogramma* Hal. (non Westw.) Ent. 1 p. VI t. K f. 4-4d (1840); Walker Notes p. 105, 114 (1872); Förster Hymenopt. Stud. 2 p. 87-88 (1856).

⁷ Philos. Magaz. (2) 2 p. 444 fig. 8, 9 (1833); Trans. Linn. Soc. Zool. (2) 1 p. 588 t. 75 f. 12, 13 (1879) antennar. fig. emendata; Vollenhoven Schetsen t. 11 (1873), antennis falsis?

⁸ Ad hoc genus verisimile etiam pertinent *Trichogramma pretiosa* Riley et *minuta* Riley.

⁹ An. N. H. (2) 7 p. 212 (1851); Förster Hymenopt. Stud. 2 p. 87, 89; = *Lathromeris* Förster l.c.

¹⁰ Hymenopt. Stud. 2 p. 87, 89 (1856); Vollenhoven Schetsen t. 11 (1873). Typ *Trichogramma walkeri* Förster Verh. naturh. Ver. preuss. Rheinl. 8 p. 26 t. 1 f. 9-9c (1854).

B. (Alae anticae haud seriatisimae steosae.)

- a. (Antennae 7-articulatae; postcosta alar. ant. marginem costalem haud attingens; terebra feminae haud exserta).

7. *Asynacta* Förster.¹¹

- b. (Antennae sex-articulatae.)

*. (Alae anticae latae, margine subtiliter ciliatae.)

8. *Brachista* Halid.¹²

**. (Alae anticae angustae, longe fimbriatae.)

9. *Oligosita* Halid.¹³

Släktet *Oophthora* står tydligen mycket nära *Trichogramma* Wetsw., med hvilket släkte det alldeles synes öfverensstämma i antennernas byggnad (pp. 251–253):

Aurivillius omitted *Paracentrobia* Howard, which I am now certain is the same as *Chaetostricha* Haliday, but adds *Calleptiles* Haliday, formerly omitted by other authors but which I think is valid. He also omits *Pentarthron* Riley which was not very adequately described and has been rightly considered a synonym of *Trichogramma*; yet strict adherence to the code makes it necessary to accept that genus for *Oophthora*, described as new here by Aurivillius, since the two are apparently the same and Aurivillius himself admits this indirectly by saying that Riley's species *minutum* and *pretiosum* belong to *Oophthora*. If *Pentarthron* is valid it undoubtedly must take precedence over the other name.¹⁴ Aurivillius also makes *Lathromeris* Foerster a synonym of *Chaetostricha* Haliday, though upon what grounds is not explained. The two genera are distinct, as has been pointed out by Howard (1898) *Prestwichia* Lubbock is also omitted from a place in the family, attention being called to it in a footnote—"Hic etiam ponendum genus *Prestwichia* Lubbock (Trans. Linn. Soc., 24, p. 140, 1863) nondum rite cognitum."

In the year following de Dalla Torre's (1898) catalogue of the Hymenoptera appeared and though containing many minor errors

¹¹ Hymenopt. Stud. 2 p. 87, 89 (1856). Annu är ingen art af detta släkte beskrifven.

¹² An. N. H. (2) 7 p. 213 (1851). *Brachysticha* Förster Hymenopt. Stud. 2 p. 88, 90 (1856). Afven af detta släkte känner jag ej nagon beskrifven art.

¹³ An. N. H. (2) 7 p. 213 (1851); Förster Hymenopt. Stud. 2 p. 88, 90 (1856). Typus *O. collina* Walker An. N. H. (2) 7 p. 212 (1851).—Hic etiam ponendum genus *Prestwichia* Lubbock (Trans. Linn. Soc. 24 p. 140 (1863) nondum rite cognitum."

¹⁴ Both are *Trichogramma*.

Footnotes 5–13 are numbered 1–9 in the original paper. The numbers are here changed to meet the exigencies of publication.—EDITOR.

as a reference work to the various components of the group proved of great aid. He omits *Prestwichia* Lubbock placing it with the Mymaridae and includes the genus *Aprostocetus* Westwood which is really eulophid. In the catalogue nine genera (including *Prestwichia*) are listed with 27 species. *Oophthora* of course was not included. The various minor errors in this important work will receive attention in more appropriate places.

Between the time of de Dalla Torre's catalogue and Aurivillius' synopsis of the family and that of the appearance of Ashmead's table of its genera several additions to the known genera and species of the family were made and are mentioned in their order before taking up a consideration of the last and one of the most important studies of the family. In 1900 Ashmead described *Brachista pallida* and *Centrobia odonatae* as new species reared from the eggs of Odonata; the former I have proved to be a synonym of (*Trichogramma*) *Abbellia acuminata* (Ashmead). Kryger (1903-1905 a and b) recorded the rearing of various genera from host eggs without mentioning the species of the genera mentioned. In 1904 Ashmead described as new *Trichogramma japonicum* and *Pentarthron brasiliense* and Mayr redescribed *Eulophus exiguus* Nees as *Asynacta exigu* (Nees), reestablishing the genus *Asynacta*, formerly without a type species, and *Brachystira pungens* new species, which becomes the type of *Brachista*, thus reestablishing that genus. The types of the two former species I have seen.

Ashmead as a culmination to his years of strenuous labor, in his monumental work on the classification of the chalcid flies (Ashmead, 1904) gives a full synopsis of the family *Trichogrammatidae* which he divides into two subfamilies—*Ologositinae* Ashmead and *Trichogramminae* Ashmead, corresponding to the two original sections or divisions made by Haliday (Walker, 1851). After reviewing the literature of the family I consider this synopsis of the genera the best one so far produced though there are many obvious errors which have had to be eliminated. Ashmead recognized nearly all of the genera so far described, with the exception of *Calleptiles* Haliday, and in the main rightly so. I have therefore contented myself in revising this table omitting such genera as *Aprobosca* Westwood and correcting the genera wrongly diagnosed. Ashmead, similarly with others, is misled in regard to *Trichogramma*, which as recognized by him is none other than

Calleptiles; so after all it is the former genus that is really omitted though the proposed new genus *Xanthoatomus* is evidently none other than it. I reproduce herewith the entire discussion of the family:

Family LXXII, Trichogrammidae.

1846. Eulophidae, Family II, (partim), Walker, List Chalc. Brit. Museum, I, p. 62.
1856. Trichogrammatoidae, Family XXII, Förster, Hym. Stud., II, pp. 20, 26 and 87.
1897. Trichogrammatinae, Underfam., Aurivillius, Entom. Tidsk., 18, p. 250.

Dr. Arnold Förster was the first to recognize this natural family, which is at once distinguished, from all other groups, by the tarsi being *3-jointed*, never more nor less.

It comes nearest to the Family *Eulophinae*, where Westwood placed his genus *Trichogramma* in 1840, and apparently forms a connecting link between that family and the next, or the *Mymaridae*.

In habits the group agrees with the *Myrmariidae*, all the species falling in it being egg-parasites.

Two subfamilies have been recognized:

Table of Subfamilies.

- Wings *without* regular rows of hairs.....Subfamily I, Oligositinae.
Wings *with* regular rows of hairs.....Subfamily II, Trichogramminae.

Subfamily I, *Oligositinae*.

In the arrangement of the pubescence of the wings this group resembles most closely the *Eulophinae*, and many of the species, but for the *3-jointed tarsi*, could be easily mistaken for species in that family.

Only five genera have been described, but it is probable that very many more exist and will be discovered when more attention is given to rearing the egg-parasites of the different orders of insects.

Table of Genera.

- | | |
|--|---|
| 1. Females..... | 2 |
| Males..... | 6 |
| 2. Antennae 6- or 7-jointed with <i>one</i> ring-joint..... | 3 |
| Antennae 8-jointed with <i>one</i> ring-joint, the funicle 2-jointed. | |
| | <i>Asynacta</i> Förster (type unknown). |
| 3. Antennae 6-jointed..... | 5 |
| Antennae 7-jointed, with a ring-joint. | |
| Ovipositor not prominent..... | 4 |
| Ovipositor prominent, at least half the length of the abdomen;
eyes oval; pedicel obconical, more than twice longer than thick; | |

flagellum fusiform, 4-jointed, the single funicle joint hardly separable from the club; wings rather narrow with a long marginal fringe. *Prestwichia* Lubbock (type *P. aquatica* Lubbock).

4. Funicle 1-jointed, the club 3-jointed.

Front wings narrow, with a long marginal fringe.

Front wings *without* a substigmatal fascia; scape straight or clavate, the single funicle joint scarcely longer than thick; eyes oblong-oval; metanotum smooth, without a carina.

Oligosita Haliday (type *O. collina* Hal. (Walker)).

Front wings *with* a substigmatal fascia; scape subclavate, arcuate, the single funicle-joint much longer than thick; eyes rounded; metanotum bicarinate. *Westwoodella* Ashmead, g. nov.

(type *Oligosita subfasciata* Westw.)

Front wings broad, with a short marginal fringe.

Brachista Haliday (type unknown).

5. ? new genus.

6. Antennae 7-jointed or less, with *one* ring-joint. 7

Antennae 8-jointed, with one ring-joint. *Asynacta* Förster.

7. Fully winged. 8

Wingless or subapterous.

Scape slender, pedicel obconical, about thrice as long as thick at apex, the flagellum fusiform 4-jointed, the single funicle joint hardly separable from the club, hind legs very long. . . *Prestwichia* Lubbock.

8. Funicle 4-jointed, the club one-jointed.

Front wings with a *long* marginal fringe.

Metanotum *without* carinae. *Oligosita* Haliday.

Metanotum bicarinate. *Westwoodella* Ashmead.

Front wings with a short marginal fringe. *Brachista* Haliday.

Subfamily II, *Trichogramminae*.

This subfamily is easily recognized by peculiarities of the front wings, the pubescence, being arranged in distinct rows or lines, a peculiarity found in no other group, except to a slight extent in some genera in the subfamily *Entedoninae*, of the family *Eulophinae*.

Table of Genera.

1. Females. 2

Males. 10

2. Veins in front wings forming a regular arch. 3

Veins in front wings *not* forming a regular arch. 4

3. Antennae 8-jointed, the flagellum clavate, the funicle 2-jointed, the joints transverse.

Body short, robust. . . *Poropoea* Förster (type *P. stollwerckii* Först.).

4. Antennae 7-jointed or less. 5

Antennae 8-jointed (scape, pedicel, *one* ring-joint, a 2-jointed funicle and a 3-jointed club).

Trichogramma Westwood (type *T. evanescens* Westw.).

5. Antennae 6-jointed or less 7
 Antennae 7-jointed.
 Wings with a short marginal fringe 6
 Wings with a long marginal fringe.
Chaetostricha Haliday (type *C. dimidiata* Hal.)
6. Antennae with the club 4-jointed (scape, pedicel, one ring-joint and a 4-jointed club) *Lathromeris* Förster (type *L. scutellaris* Först.)
7. Antennae 3- or 6-jointed, *without* a ring-joint 8
 Antennae 6-jointed, *with* a ring-joint (scape, pedicel, one ring-joint, a 2-jointed funicle and a solid club).
 Abdomen shorter than the thorax.
Xanthoatomus Ashmead, gen. nov. (type. X).
 Abdomen subcylindrical, longer than the thorax.
Pentarthron Riley (type *Trichogramma minutum* Riley).
8. Antennae 3-jointed 9
 Antennae 6-jointed, the club 3-jointed (scape, pedicel, a 1-jointed funicle and a 3-jointed club.)
 Postscutellum not distinct, *without* a triangular projection.
Centrobia Förster (type *Trichogramma Walkeri* Först.).
 Postscutellum distinct, *with* a triangular projection.
Paracentrobia Howard (type *P. punctata* How.).
9. Club not jointed.
 Marginal fringe not especially long, the marginal vein not more than twice as long as the stigmal vein *Aprobosca* Westwood.
10. Antenne 7-jointed or less 11
 Antennae 8-jointed.
 Veins of front wings forming a regular arch; flagellum filiform.
Poropoea Förster.
 Veins of front wings not forming a regular arch.
Trichogramma Westwood.
11. Antennae 6-jointed or less 12
 Antennae 7-jointed.
 Wings with a very long marginal fringe *Chaetostricha* Holiday.
 Wings with a short marginal fringe.
 Club of antennae 4-jointed *Lathromeris* Förster.
 Club of antennae 3-jointed *Pentarthron* Riley.
12. Antennae 6-jointed (scape, pedicel, a 1-jointed funicle and a 3-jointed club), marginal vein about thrice as long as the stigmal.
Centrobia Förster.
 Antennae 3-jointed (scape, pedicel and a long, solid club); marginal vein not more than twice the length of the stigmal vein.
Aprobosca Westwood (type *A. erosicornis* Westw.), pp. 358-361.

This table should be closely compared with my own given partly in part I, but now revised and completed at the end of this paper.

Mayr (1904) describes the types of *Asynacta* Foerster and *Bra-*

chista Haliday and it is on this basis that Ashmead's diagnosis of these genera are considered erroneous; I have corrected (Girault, 1911 d) part of his description of *Prestwichia* from actual specimens; *Westwoodella* I have made a synonym of *Oligosita*, since its characteristics do not hold; *Poropoea* I have also seen and corrected; *Trichogramma* I have corrected after exhaustive study¹⁵ (Girault, 1911 j); *Chactosticha* I correct from the original description; *Xanthoatomus* and *Pentarthron* are proved synonyms of *Trichogramma*; *Paracentrobia* agrees with *Brachista* and from the descriptions I make them synonyms; and *Aprobosca* is probably a male *Trichogramma*.

In 1906, I showed the great color variation in *Trichogramma*, describing a new variety of *Trichogramma minutum* (Riley) and in the same year Perkins described a new new genus from Australia (*Pterygogramma*), which I have subsequently revised and added to. In the same and following year I summarized much of the biology of *Trichogramma minutum* (Riley). At the same time Schmiedeknecht (1907, 1909) gave generic synopses of the group and in 1910 I severely criticized Schmiedeknecht 1909, showing that his last and fuller synopsis was unreliable and based on Ashmead (1904), proved above to be largely erroneous. At the same time, the genera and species of the family were summarized, admitting fourteen valid genera and thirty-two valid species. In the meanwhile, Howard (1909) confirmed the original description of *Poropoea* Foerster and stated that *Centrobia* was different from *Trichogramma*; Masi (1909) reviewed *Oophthora* Aurivillius stating that *Trichogramma minutum* Riley belonged with that group and that *Xanthoatomus* Ashmead was also *Oophthora*; he also made (*Pentarthron*) *Trichogramma carpocapsae* (Ashmead) a synonym of (*Oophthora*) *Trichogramma semblidis* (Aurivillius) by comparing the two. This was accepted, but later examination of the types of *carpocapsae* made by myself showed that the two were quite distinct. Claude Morley in 1910 gave the catalogue of the British forms of the family, listing four genera and seven species, among them the tetrastichine genus *Aprostocetus* with three of the species. This catalogue is made up from the literature and is without value.

¹⁵ Dr. L. O. Howard has stated to me in a letter that he has seen the type of *Trichogramma evanescens* Westwood and that it is congeneric with *Trichogramma minutum*.

In 1911 and 1912 I completed my studies of the family, identifying the old species, making large additions to the known genera, and giving in two places (Girault, 1912 *b* and *e*) partial tables of genera. These tables are now summarized, combined and amended, adding two additional genera and one subgenus and sinking two of the former genera into synonyms. These genera are *Brachistella* Girault (= *Abbella* Girault and *Neotrichogramma* Girault (= *Trichogramma* Westwood). With the following table and catalogue, therefore, I consider it needful to give a final summary of the family down to the month of July, 1913. As far as I know this summary is *complete*, including every systematic unit of the group. In part III, then, it remains merely to give a biological history of it, a bibliography and one or two paragraphs concerning methods for collecting, preserving and studying these extremely interesting but exceedingly small insects.

(To be continued.)

BRISBANE, AUSTRALIA,
July, 1913.

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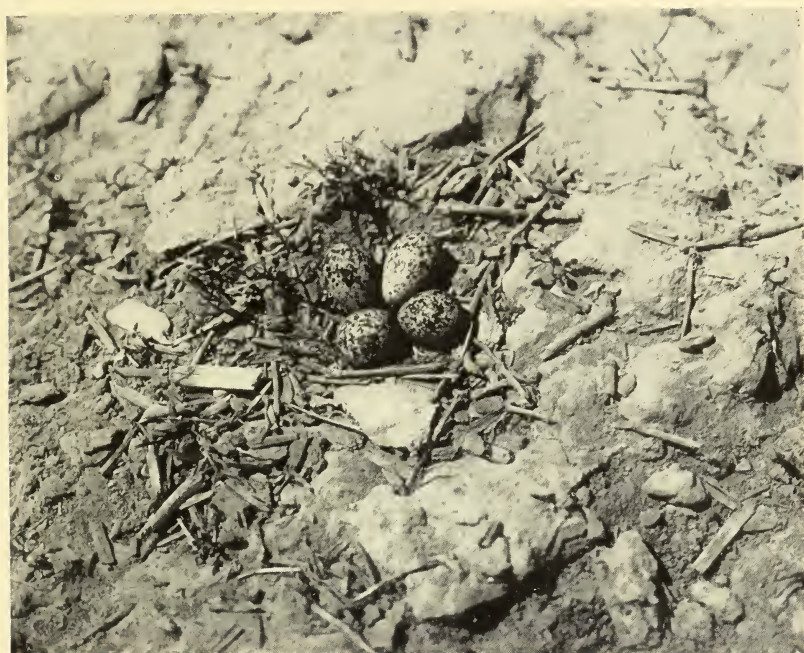
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